HEAR PILOT-TO-TOWER TALK WHILE IN FLIGHT

Popular Electronics

WORLD'S LARGEST- SELLING ELECTRONICS MAGAZINE

MAY 1977/\$1.25

FOR HI-FI BUFFS

- HOW TO MATCH STEREO COMPONENTS BY \$\$\$
- HIRSCH-HOUCK LABS EXAMINES:
 SENNHEISER'S WIRELESS STEREO HEADPHONES
 TEAC'S PORTABLE STEREO CASSETTE DECK

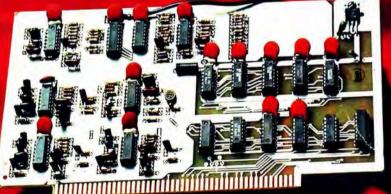
FOR COMMUNICATION HOBBYISTS

- MORSE CODE ALPHANUMERIC READOUT ON TV
- **TESTING KENWOOD'S DIGITAL HAM TRANSCEIVER**

HANDS-ON REPORT FOR EXPERIMENTERS

•THE NEW "NO CAMERA" PC BOARD KITS

VOICE COMMUNICATIONS WITH



COMPUTERS!

...speech recognition device substitutes for keyboard





A MAJOR PROJECT BREAKTHROUGH



The 40-channel Cobra 29XLR. From the sleek brushed chrome face to the matte black housing, it's a beauty. But its beauty is more than skin deep. Because inside, this CB has the guts to pack a powerful punch.

The illuminated 3-in-1 meter tells you exactly how much power you're pushing out. And pulling in. It also measures the system's efficiency with an SWR check. In short, this Cobra's meter lets you keep an eve on your ears.

The Digital Channel Selector shows you the channel you're on in large LED numerals that can be read clearly in any light. There's also switchable noise blanking to reject short-pulse noise other systems can't block. The built-in power of DynaMike Plus. Automatic noise limiting

and Delta Tuning for clearer reception.

And the added protection of Cobra's nationwide network of Authorized Service Centers with factory-trained technicians to help you with installation, service and advice.

The Cobra 29XLR. It has 40 channels. And it has what it takes to improve communications by punching through loud and clear on every one of them. That's the beauty of it.



Punches through loud and clear.

Cobra Communications Products
DYNASCAN CORPORATION

6460 W. Cortland St., Chicago, Illinois 60635

Write for color brochure

EXPORTERS: Empire • Flamview, N.Y. • CANADA: Atlas Electronics • Toronto

CIRCLE NO 15 ON FREE INFORMATION CARD

PUNCH AND BEAUTY





Whether you're a seasoned practitioner or a striving beginner...

Here are the fundamentals.

Software Design for Microprocessors. 378 pages only \$12.95.*

Basic Electricity and DC Circuits. 1,016 pages only \$19.95.*

Both of these new books get down to basics—present clear, readable discussions. Loaded with examples, references, graphs, tables. Also, data sheets, bibliography and appendices. You're encouraged to learn—and apply your knowledge to practical situations.

Software Design for Microprocessors. Helps you understand the hardware/software relationship of microprocessors. A convenient, standalone text, suitable for both first-time users of microprocessors and the technically advanced.

Beginning chapters deal with basic terms, basic machine architecture, instructions and addressing. Successive chapters treat the process of generating software, defining required support and documentation, and designing a simple machine to program a problem. Sample problems at the conclusion allow you to apply your new knowledge.

Basic Electricity and DC Circuits.

A self-teaching course designed to enable you to predict and control the behavior of most basic and complex DC circuits. Each lesson begins with a listing of objectives — what new skills and knowledge you should have upon successful completion. The text within each chapter is arranged so that you progress at your own pace, with answers to commonly asked questions presented at key points.

Examples show you how to use the principles of basic DC electricity as

they are taught. You'll analyze basic DC circuit schematics and find yourself experimenting with your own designs. Plus, a quiz included at the end of each lesson allows you to gauge your progress.

If you're a hobbyist, student, or simply interested in broadening your knowledge of electronics, these

books are *must* additions to your library. Use the coupon below to order your copies today.



Texas	instrument	s Learn	ing	Cent	er

Mail checks and money orders to: P.O. Box 3640, M/S 84, Dallas, Texas 75285. Postage paid. Add state and local taxes where applicable.

Mail company purchase orders to: P.O. Box 5012, M/S 84 Dallas, Texas 75222. Postage and taxes will be added to your invoice.

Please send me___copies of (LCB 1891) Software Design for Microprocessors at \$12.95° per copy. ___copies of Basic Electricity and DC Circuits at \$19.95° per copy.

Lenches	a 🗆 ch	ack El mo	oney order for \$	· v p	, Sec.
1 01101031	e LJ Gi	eck (2) life	nicy drain for wall	4-	3
Name		1.5		1,42	
Address			-		
	Dar	14.			

*Suggested retail price; subject to change without notice; (c) 1976 Texas Instruments Incorporated



"Roar Power" puts these new 40-channel CB's from **Pearce-Simpson out in front.** The Lion 40[™] and Tiger 40[™]. Built with all the power and prestige you'll ever need in the CB jungle. As well as some advanced Pearce-Simpson features that command real attention. Like HetroLock™, for zeroing in on the right frequency. Receiv-O-Slide™ tuning for the best reception and superior adjustment of signals (even from "off-freq." sets). And the Lion's bold new LED digital read-out.

Both sets are backed by Pearce-Simpson's over quartercentury of experience in personal two-way communications. And both are available right now. So stop by your Pearce-Simpson dealer today. He'll be glad to help you make the big cats roar.

For further information, write Pearce-Simpson, 4701 N.W. 77th Ave., Miami, FL 33166. In Canada, Scotcomm Radio, Inc., 4643 Levesque Blvd., Chomesday, Laval,







DIVISION OF GLADDING CORPORATION

THE CB RADIO · MARINE RADIO · ANTENNA PEOPLE.

CIRCLE NO. 47 ON FREE INFORMATION CARD

POPULAR ELECTRONICS

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE

FEATURE ARTICLES

NEW "NO-CAMERA" PRINTED CIRCUIT BOARD METHODS	ri 55
How to make etching and drilling guides directly from printed matter.	-
HOW TO MATCH HI-FI COMPONENTS	- 66
Price tags serve as a good guide to apportioning your money.	-
MAY-AUGUST ENGLISH-LANGUAGE SW BROADCASTS	101
CONSTRUCTION ARTICLES	
INTRODUCING SPEECHLAB—THE FIRST HOBBYIST VOCAL INTERFACE FOR A COMPUTER	
Horace Enea and John Reykjalin	43
Now your computer can respond to vocal commands.	-
BUILD A LEGAL IN-FLIGHT AIRLINE RECEIVER	61
Hear pilot-to-control conversations with low-cost Varactor-diode crystal set.	
MORSE CODE AUTOMATIC READOUT ON A TV SCREEN	64
Interface the Morse-A-Letter to a "TV Typewriter."	
COLUMNS	
STEREO SCENE	18
The Decontamination Squad.	
SOLID STATELou Garner	76
VMOS—MOSFET's With Muscle.	
EXPERIMENTER'S CORNER	86
Using LED's as Light Detectors.	
HOBBY SCENE	88
COMPUTER BITS	96
Debugging Aids.	
CB SCENE	98
Uncle Charlie Is Snowed-In.	
DX LISTENING	100
JULIAN HIRSCH AUDIO REPORTS	
HOW HEADPHONES ARE TESTED	26
SENNHEISER MODEL HDI 434 INFRARED HEADPHONES	32
TEAC MODEL PC-10 CASSETTE RECORDER	36
ELECTRONIC PRODUCT TEST REPORTS	
KENWOOD MODEL TS-820 TRANSCEIVER	90
MURA MODEL PRX-100 "PRM" CB MICROPHONE	
B&K PRECISION MODEL 1471B OSCILLOSCOPE	94
DEPARTMENTS	
EDITORIAL	
The CB Crossover Point.	4
LETTERS	6
NEW PRODUCTS	
NEW LITERATURE	
NEWS HIGHLIGHTS	

POPULAR ELECTRONICS, May 1977, Volume 11, Number 5, Published monthly at One Park Avenue, New York, NY 10016. One year subscription rate for U.S., \$9.98; U.S. Possessions and Canada, \$12.98; all other countries, \$14.98 (cash orders only, payable in U.S. currency). Second Class postage paid at New York, NY and at additional mailing offices. Authorized as second class mail by the Post Office Department, Offawa, Canada, and for payment of postage in cash.

POPULAR ELECTRONICS including ELECTRONICS WORLD, Trade Mark Registered. Indexed in the Reader's Guide to Periodical Literature.

COPYRIGHT © 1977 BY ZIFF-DAVIS PUBLISHING COMPANY. ALL

RIGHTS RESERVED.

Ziff-Davis also publishes Boating, Car and Driver, Cycle, Flying, Modern Bride, Popular Photography, Skiing and Stereo Review.

Material in this publication may not be reproduced in any form without permission. Requests for permission should be directed to Jerry Schneider, Rights and Permissions, Ziff-Davis Publishing Co., One Park Ave., New York, NY 10016.

Editorial correspondence: POPULAR ELECTRONICS, 1 Park Ave., New York, NY 10016. Editorial contributions must be accompanied by return postage and will be handled with reasonable care; however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

Forms 3579 and all subscription correspondence; POPULAR ELECTRONICS, Circulation Dept., P.O. Box 2774, Boulder, CO 60302. Please allow at least eight weeks for change of address. Include your old address, enclosing, if possible, an address label from a recent issue.

Popular Electronics®

EDGAR W. HOPPER

Publisher

ARTHUR P. SALSBERG

Editoral Director

LESLIE SOLOMON

JOHN R. RIGGS

JOHN R. HIGGS Managing Editor

IVAN BERGER

Senior Editor

ALEXANDER W. BURAWA Features Editor

EDWARD I. BUXBAUM

Art Director

JOHN MEVEIGH

Associate Editor

ANDRE DUZANT

Technical Illustrator

PATRICIA GIRRIER-BROWN

Fraduction Editor

Contributing Editors
HAL CHAMBERLIN, LOU GARNER
GLENN HAUSER, JULIAN HIRSCH
RALPH HODGES, FORREST MIMS
RAY NEWHALL, WILFRED SCHERER

JOSEPH E. HALLORAN

Advertising Director

JOHN J. CORTON

Advertising Sales

LINDA BLUM Advertising Service Manager

PEGI MCENEANEY

Executive Assistant

STANLEY NEUFELD Associate Publisher

ZIFF-DAVIS PUBLISHING COMPANY

Popular Electronics Editorial and Executive Offices One Park Avenue New York, New York 10016 212-725-3500

Hershel B. Sarbin, President Furmari Hebb, Execulive Vice President John R. Emery, Sr. Vice President, Finance and Treasurer Phillin T. Heffernan, Sr. Vice President

Phillip T. Heffernan, Sr. Vice President

Edward D. Muhlfeld, Sr. Vice President, Sports Division

Phillip Sine, Sr. Vice President

Frank Pomerantz, Vice President, Creative Services Arthur W Butzow, Vice President, Production Lawrence Sporn, Vice President, Cimulation George Morrissey, Vice President Sydney H Rogers, Vice President Sidney Holtz, Vice President Albert S Traina, Vice President Philip Korsant, Vice President Paul H Chook, Vice President Edgar W Hopper, Vice President Charles B, Seton, Secretary

William Ziff, Chairman W Bradford Briggs, Vice Chairman

Midwestern Office The Pattis Group, 4761 West Touhy Ave., Lincolnwood, Illinois 80844, 312 679-1100 Thomas Hockney, Michael Neril, Gerald E, Wolfe Western Office

9025 Wilshire Boulevard, Beverly Hills, CA 90211 213 273-8050; BRadshaw 2-1161 Western Advertising Manager: Bud Dean

Japan: James Yagi Oji Palace Aoyama; 6-25, Minami Aoyama 6 Chome, Minato-Ku, Tokyo 407-1930/6821, 582-2851









The publisher has no knowledge of any proprietary rights which will be violated by the making or using of any items disclosed in this issue.



Editorial

THE CB CROSSOVER POINT

I felt the pulse of the CB industry this past February at the second annual Personal Communications 2-Way Radio Show, where some 380 manufacturers exhibited their newest CB transceivers, antennas and accessories. It was strong, though beating a little slower than in the recent past. Clearly, the crossover sales point from 23-channel CB transceivers to 40-channel units had not yet been reached in February, although indications are that it will have happened by the time you read this.

A transition period is, of course, a natural state of events, especially when the old and the new are running side by side, with the former sold at spectacular discounts. What we were watching at the PC-77 trade show was "tomorrow," while "today" was having its last hurrah in the marketplace. Making my way through the exhibit hall, I became aware of a few 40-channel misconceptions shared by some dealers and distributors—and perhaps passed on to their customers. Two of them were: 40-channel CB transceivers only produce two watts of r-f output power and they exhibit inferior modulation. Both are fallacious, of course!

Now, really, there is simply no reason why, given good design, expanding a band of frequencies a paltry 150 kHz should influence r-f power output or modulation capability. Sure, a warmed-over 23-channel design that exhibited poor automatic modulation limiting to begin with won't be able to hack it, though passing FCC type-acceptance tests. (These are actually being performed now. The "good old days" of passing tests by submitting paper results to the FCC are over, thankfully). However, we've tested enough new 40-channel rigs to verify that they can provide as much r-f carrier output power and modulation throughout the new, expanded band as the 23's. Moreover, the new rigs are decidedly less prone to overmodulate owing to improved modulation limiters. This means fewer cases of voice distortion and, more important, less splatter to interfere with adjacent channel communication.

Interestingly, the foregoing points were emphasized by a major CB radio manufacturer at a Show press meeting. Furthermore, a spokeman analyzed the signal strength required at the receiver for a standard 10-dB signal-to-noise ratio in a typical urban environment to illuminate another advantage for 40-channel rigs. Assuming a typical receiver sensitivity of 0.5 microvolts for 10-dB (S + N)/N, about 14.5 microvolts of additional signal strength is required for the current 23 channels to make the standard due to interference from on-channel users; 15 microvolts more at the receiver is needed to combat adjacent-channel interference, for a total of 30 microvolts. In contrast, the upper new channels require only a total of 1.5 microvolts to receive an intelligible communication, the manufacturer estimated.

As a consequence of the above, the communication range with the upper new channels is estimated to be four times that of the lower 23 channels (30 microvolts/1.5 microvolts = 20 times = 26 dB). Typical area coverage on the new channels (actually, 80% of the upper new ones, since some are still within splatter distance of the original 23) would, therefore, be enlarged about 16 times.

For CB'ers trying to get through during rush-hour traffic, the upper 17's on a 40-channel AM rig might be considered to simulate the effectiveness of single sideband on one of the less popular lower 23 channels. So, though 23-channel transceivers are tremendous bargains (and hard to resist), right now, 40 channels is the way to go to fully appreciate the utility of the citizens band.

art Salaberg

One Call. Your Mallory distributor's got them all.

Take the search and wait out of your electronic parts finding.

Go straight to your Mallory distributor, by phone or in person.

Get to know the convenience and economy of simplified single-source buying. To deliver exactly what you want in parts, quality, and quantity. Immediately from stock on hand, or in most cases within 24 hours from the factory.

Your Mallory distributor goes all out for his Number 1 VIP... you. Get in touch with him soon. Mallory Distributor Products Company, a division of P. R. Mallory & Co. Inc., Box 1284, Indianapolis, Indiana 46206. (317) 856-3731.



MALLORY

Capacitors • Controls • Fastening Devices • Resistors • Security Products • Semiconductors • Solderless Terminals • Switches



ABOUT PC ARTWORK

I recently tried, for the first time, GC Electronics' new Lift-It direct-art pc kit and have a few questions I hope you will answer. First, if I attempted to use the Lift-It master to directly expose positive-resist-treated pc blanks, would it work? I fear that the black ink will not have the density required to block out light. Secondly, if the Lift-It artwork would work, what are chances for POPULAR ELECTRONICS to print the pc etching and drilling guides as negative artwork so that one-timers like me could use commonly available negative resist without having to reverse the exposure mask? —Warren D. White, Berkeley, CA.

We have used the Lift-It artwork directly to expose presensitized pc blanks with a high degree of success. During our experience, we have not had one instance where the ink was not dense enough to exclude light. (For detailed information about the Lift-It kit and another direct-art kit from Datak, see the leature article in this issue.)

As for printing our pc etching and drilling guides as negative artwork, we have anticipated you. As you can see, beginning in this issue, our pc artwork is now printed in the negative format. We have taken this step because a recent survey revealed that almost all spray-on photoresist available to the hobbyist is the negative variety (although GC Electronics does sell a positive photo-resist). By printing our pc artwork in negative format, readers can save at least one step in the board fabrication process.

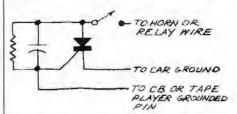
CONSTANT VERSUS VARIABLE

I believe that the explanation of dual-slope analog-to-digital conversion on page 37 of the "Multimeters For Electronics" story (February 1977) is incorrect. The T_1 to T_2 time period is a constant—a specific number of oscillator pulses—not a variable as stated in the text, —David E. Purdy, Philadelphia, PA

You're correct. It's the T_2 to T_3 time that's the variable.

SIMPLE TO SIMPLER

The SCR trigger circuit for possible use in protecting CB and other electronic equipment in automobiles shown in the January 1977 CB Scene can be further simplified when applied to CB transceivers. This is particularly true in the case where the rig has a three-prong plug for the 12-volt line and one of the prongs is not used. In my circuit (see below),



note the elimination of the relay. Wire #3 goes to the unused prong of the plug, while the unused contact in the mating female connector goes to ground. Removal of the power cable or physical removal of the CB rig or tape recorder from the vehicle will trigger the vehicle's horn. From actual experience, I can attest that the circuit has paid for itself in value of equipment protected. —Robert B. McKinley, Jr., Tinton Falls, NJ.

AMPLIFIER DIAGRAMS SWITCHED

In my article "Classes of Audio Amplifiers" (March 1977), the diagrams for Figs. 5 and 6 have been interchanged. The captions are correct.—Len Feldman.

SILENCER PC BOARDS AVAILABLE

Although no source was given for pc boards in my article "Build a Silencer" (March 1977, p 57), they are available from me at the following address: Ronald Miles, Rte. 1, Box 190, Rustburg, VA 24588. Price is \$4.60 per board. Virginia residents, add 4% sales tax.

About damping, bi-amping and the Crown DC-300A

Because of inertia, speaker transducers over-react to amplifier signals. This can be minimized by speaker design, but it can't be eliminated entirely. In the process, the transducers feed spurious signals back into the signal processing units.

A good amplifier is designed to control excessive transducer excursions by reducing — and absorbing — the unwanted signals generated by such excursions. It's part of a process audio engineers call damping. The Crown DC-300A power amplifier, in addition to its other well-known specifications, has a damping factor of 700, which means it should easily control speaker excursions. (A rating of 400 is considered good.)

But in a standard hi-fi stereo system, the DC-300A can't do all the damping it was designed for. The sound is a little muddler than it should be.

Why? Because the speaker crossovers — with their own impedance get in the way. The amp is not directly hooked up to the transducers.

Solution? Move the crossovers back between amp and pre-amp. Add another DC-300A and bi-amp the speakers.

The DC-300A now damps excessive transducer excursions efficiently. Which can mean crisper, cleaner sound.

Each transducer now has 155 watts of power available to drive it, and is limited only by its own characteristics. Which can mean more sound pressure

There can also be less distortion, since harmonics of low-frequency distortion cannot feed to high-frequency transducers through the crossover.

Are you interested in how to use all the power and performance of a Crown DC-300A amplifier? Write. We'll send you information about the Crown VFX-2A, a two-channel variable-frequency crossover that makes bi-amping easy. Plus reprints of some articles that may help you decide if bi-amping is for you.

Crown VFX-2A







ay we send you your choice of these 3 practical, time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you, through your own experience, that these very real advantages can be yours...that it is possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway...without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 3 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY! If you are not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

FLECTRONICS BOOK CLUB, P.D. Box 10, Blue Ridge Summit, Pa. 17214

Facts About Club Membership

- The 3 introductory books of your choice carry publishers' retail prices of up to \$62.70. They are yours for only 99c each (plus postage/handling) with your Trial Membership.
 You will receive the Club News, describing the current
- Selection, Alternates and other offerings, every 4 weeks (13
- If you want the Selection, do nothing; it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you imply give instructions on the reply form (and in the velope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- Ton, you may return it at those expense.

 Personal service for your account—no computers used!

 To complete your Trial Membership, you need buy only four additional monthly selections or alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully re-
- turnable after 10 days if you're not completely satisfied.

 All books are offered at low Member prices, plus a small stage and handling charge.
- Continuing Bonus: If you continue after this Trial Mem-bership, you will earn a Dividend Certificate for every book you purchase. Three Certificates, plus payment of the nominal sum of \$1.99, will entitle you to a valuable Book Dividend of your choice which you may choose from a list

ELECTRONICS BOOK CLUB

P.O. Box 10

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 3 books circled below. I understand the cost of the books I have selected is only 99¢ each, plus a small shipping charge. If not de-lighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months, after which I may cancel my mem-

101		132/62	7/672		563/636	62	8/637
	652		714	74	3 74	8/749	
754	785	800	836	841	855/885	891	970

Name	Phone
Address	
City	
State	Zip
	mbers only. Foreign and Canada add 10%) PE-57

Where do the pros get their training?



Almost half of the successful TV servicemen have home study training and with them, it's NRI 2 to 1.

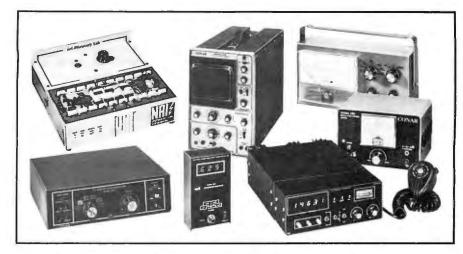
It's a fact! Among men actually making their living repairing TV and audio equipment, more have taken training from NRI than any other home study school. More than twice as many!

A national survey*, performed by an independent research organization, showed that the pros named NRI most often as a recommended school and as the first choice by far among those who had taken home study courses from any school. Why? Perhaps NRI's 62-year record with over a million students . . . the solid training and value built into every NRI course . . . and the designed-forlearning equipment originated by NRI provide the answer. But send for your free NRI catalog and decide for vourself. .



Two Famous Educators... NRI and McGraw-Hill.

NRI is a part of McGraw-Hill, world's largest publishers of educational material. Together, they give you the kind of training that's geared for success . . . practical know-how aimed at giving you a real shot at a better job or a business of your own. You learn at home at your convenience, with "bite-size" lessons that ease learning and speed comprehension. Kits designed to give you practical bench experience also become first-class professional instruments you'll use in your work.



25" Diagonal Color TV... And 4-channel Quadraphonic Stereo.

As a part of NRI's Master Course in color TV/Audio servicing, you build a 25" diagonal

solid state color TV with console cabinet. As you build it, you perform stage-by-stage experiments designed to give you actual bench experience. And you get a Quadraphonic system with 4 speakers. NRI's

instruments are
a cut
above the
average,
including
a transistor-

ized volt ohm-

meter, triggered sweep 5" oscilloscope, CMOS digital frequency counter and digital integrated circuit color TV pattern generator. They're top professional quality, designed to give you years of reliable service. You can pay hundreds of dollars more for a similar course and not get a nickel's worth extra in training and equipment.

Widest Choice of Courses and Careers.

NRI doesn't stop with just one course in TV/Audio servicing. You can pick from five different courses (including an advanced color course for practicing technicians) so you can fit your training to your needs and your budget. Or, you can go into Computer Technology, learning on a real, digital computer you build yourself. Communications with your own 400 channel digitally-synthesized VHF transceiver. Aircraft or Marine Electronics. CB. Mobile Radio, and more.

Free Catalog... No Salesman Will Call.

Send the postage-paid card for our free color catalog showing details on all NRI electronics courses. Lesson plans, equipment, and career opportunities are fully described. Check card for information on G.I. benefits. No obligation, no salesman will call. Mail today and see for yourself why the pros select NRI two to one!

If card is missing, write,



*Summary of survey results upon request. NRI SCHOOLS

McGraw-Hill Continuing Education Center 3939 Wisconsin Avenue, Washington, D.C. 20016



Additional information on new products covered in this section is available from the manufacturers. Either circle the item's code number on the Reader Service Card inside the back cover or write to the manufacturer at the address given.

PRESIDENT 40-CHANNEL CB TRANSCEIVER

The "Zachary T" 40-channel CB AM basestation transceiver from President Electronics features a new automatic speech compression circuit and a PLL in the frequency synthesizing system. The compressor is designed to provide consistent high-level modulation, while the PLL circuit is said to provide



better on-frequency response than is possible with a conventional synthesizer. Selectivity is rated at -65 dB. Controls include volume, r-f and mike gain, anl (with manual override) and PA/CB switches. Also on the front panel is an S/r-f meter. Back-panel jacks provide for both ac and dc power input, antenna connection, and hookup of PA and external speakers. The earphone and mike jacks are up front. The transceiver also features a LED numeric channel display. \$249.95.

CIRCLE NO 92 ON FREE INFORMATION CARD

SANSUI HIGH-POWER STEREO RECEIVER

Sansui's high-power Model 9090DB AM/ stereo FM receiver is rated at 125 watts / channel (8 ohms) minimum rms at no more than 0.1% THD. The power amplifier is directcoupled throughout, with fully complementary parallel push-pull OCL circuitry. Twin power meters provide convenient output power monitoring. Built in is a Dolby noise reduction system that can be used for both encoding and decoding for full flexibility. The tuner section features a PLL IC multiplex demodulator



that provides improved stereo separation on FM. FM sensitivity is rated at 9.8 dBf (1.7 μ V) and capture ratio and alternate-channel selectivity are rated at 1.5 and 85 dB, respectively. A front-panel microphone jack, with its own level control, permits mixing any selected source with the microphone signal for use in PA systems. \$750.

CIRCLE NO 93 ON FREE INFORMATION CARD

CIBCO CB PERFORMANCE MONITOR

A constant CB performance indicator that features light-emitting diodes for easy monitoring of SWR and transmitter output power is available from CiBco Division of Southwest Factories, Inc. The Model CPi II in-line monitor employs a green LED that indicates trans-



mission output of 3.5 watts or more. A red LED comes on when reflected power exceeds a 1.8:1 SWR. (The red LED doubles as a speech modulation indicator.) Indications are produced automatically by pressing the microphone switch. In case of trouble, the red LED flashes an immediate warning. Hence, shorting or theft of the antenna is immediately evident, preventing damage to the output transistors in a CB transmitter. The monitor comes with a PL259 connector for easy installation between transceiver and antenna. \$19.95. Address: CiBco Div., Southwest Factories, Inc., 3801 Willow Springs, Oklahoma City, OK 73112.

MICRO-ACOUSTICS PHONO CARTRIDGE

The Model 282-e stereo phono cartridge from Micro-Acoustics has a unique design that is said to enable it to track warped records 25% better than competitive cartridges. It is also said to be immune to the effects of cable ca-



pacitance and not to be tonearm sensitive. The cartridge is fitted with a 0.002×0.007 mil elliptical diamond stylus. Frequency response is rated at 5 to 20,000 Hz ± 2 dB, tracking force range at 0.75 to 1.5 grams, separation at nominally 25 dB at 1000 Hz (15 dB et 10,000 Hz), and output voltage at 3.5 mV/channel at 5 cm/s peak recorded velocity. Load requirements are not critical and can

be anywhere in the range from 10,000 to 100,000 ohms. Similarly, cable capacity is not critical at 100 to 1500 pF.

CIRCLE NO. 94 ON FREE INFORMATION CARD

AMI MICROCOMPUTER KIT

American Microsystems, Inc., is offering its S6800 µP in kit form for computer hobbyists. The top-of-the-line Model EVK 200 kit contains all necessary components for complete construction, including a preprogrammed ROM for system monitor and general software utilities. Only a power supply and suitable I/O devices are required for operation. Level-control circuitry, baud-rate generation (50 to 9600 baud), and adjustability are built into the basic board. The CPU is the AMI S6800 eight-bit chip, with an instruction execution of 2 us and memory access time of 575 ns. The system provides four available interrupt vectors and three types of DMA. A 1-MHz clock provides a 100-µs and 1-ms timer. Also on-board are the I/O interfaces and an EPROM programmer (EPROM device included). \$495. (Also available fully assembled as Model EVK 300 for \$765.)

CIRCLE NO. 95 ON FREE INFORMATION CARD

AVA LOGIC PROBE

The Catch-A-Pulse logic probe from AVR is compatible with RTL, DTL, TTL, CMOS, MOS, and with microprocessors using 3.5-V to 15-V power supplies. Thresholds are automatically programmed for multi-logic-family operation. The memory circuit for single or



multi-pulse detection resets automatically. LED's indicate high and low levels, open-circuit logic, and pulses. Designed for carrying in a shirt poscket, the probe has a protective cap for the top, and a removable coiled cord. \$24.95.

CIRCLE NO. 96 ON FREE INFORMATION CARD

KOSS ELECTROSTATIC STEREOPHONES

The Model ESP/10 alectrostatic stereo headphones made by Koss plug into an electrostatic energizer unit that can be operated on as little as 25 watts of continuous power per channel. The energizer, which accommodates two sets of headphones, has semi-



Old Fashion WALUE in the Manual Tradition

Our 6800 computer system represents the best value available today, with no sacrifice in performance.

I would like to explain why this is true. The most basic reason is that the 6800 is a simpler, more elegant machine. The 6800 architecture is memory oriented rather than bus oriented as are the older 8008, 8080 and Z-80 type processors. This is an important difference. It results in a computer that is far easier to program on the more basic machine language and assembly language levels. It also results in a far simpler bus structure. The 6800 uses the SS-50 bus which has only half the connections needed in the old S-100 (IMSAI/MITS) bus system. If you don't think this makes a difference, take a look at the mother boards used in both systems-compare them. The SS-50 system has wide, low impedance 0.1 lines with good heavy, easily replaced Molex connectors. The S-100 bus, on the other hand, has a very fine hair-like lines that must be small enough to pass between pins on a 100 contact edge connector. I'll give you one guess which is the most reliable and noise free. As for cost-well any of you who have purchased extra connectors for your S-100 machines know what kind of money this can run into. The 6800 is supplied with all mother board connectors. No extras, or options like memory, or connectors for the mother board are needed in our 6800 system.

The 6800 is not beautiful, but "Oh Boy" is it functional. That plain black box is strong and it has an annodized finish. This is the hardest, toughest finish you can put on aluminum. Most others use paint, or other less expensive finishes. The 6800 does not have a pretty front panel with lights and multicolor switches. This is because the lights and switches are not only expensive, and unnecessary, but also a great big pain to use. We don't crank up the 6800; we use an electric starter-a monitor ROM called Mikbug. He automatically does all the loading for you without any time wasting switch flopping. So in the 6800 system you don't buy something expensive (the console) that you will probably want to stop using as soon as you can get your hands on a PROM board and a good monitor.

That's another thing. Mikbug[®] is a standard Motorola part. It is used in many systems and supported by the Motorola software library in addition to our own extensive collection of programs. It is not an orphan like many monitor systems that are unique to the manufacturer using them and which can only run software provided by that manufacturer. Check the program articles in Byte, Interface and Kilobaud. You will find that almost all 6800 programs are written for systems using a Mikbug[®] monitor. Guess how useful these are if you have some off-brand monitor in your computer.

The 6800 will never win any beauty prizes. It is like the Model "T" and the DC-3 not pretty, but beautiful in function. It is simple, easy to use and maintain and does its job in the most reliable and economical way possible. What more could you want?

Mikbug ® is a registered trademark of Motorola Inc.

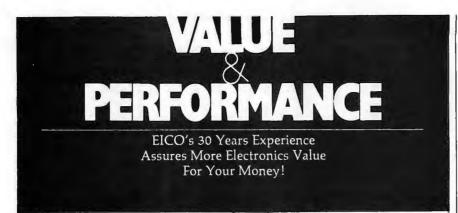


Computer System

with serial interface and 4,096 words of memory \$395.00



☐ Enclosed is \$395 for r	ny SwTPC Computer Kit Send D	ata
Or BAC	#	
or MC	Ex Date	
,		
NAME		
ADDRESS		
CITY	STATE ZIP	



TEST INSTRUMENTS



EICO 388 COLOR BAR GENERATOR

Pocket-size, battery operated with LED Indicator, MOS LSI IC provides 9 digitally controlled, stable patterns. Crystal controlled chroma and timing oscillators. Simply connects to TV's VHF antenna terminals.

Wired \$89.95

EICO 390 FUNCTION/SWEEP GENERATOR

Outstanding features include: Sine, Square, Triangle Waveforms; .2 Hz to 200 KHz frequency range; Linear and Log Sweep; Calibrated attenuator, VCO for External Frequency ibrated attenuator, voo ior Eaconame Control; BNC Front Panel Output. Wired \$169.95

CB ACCESSORIES



EICO 700 CB FREQUENCY COUNTER

Compact in-line mobile frequency counter for the serious CB'er/Hobbyist. Operates automatically on transmit. 10 Hz to 30 MHz. \$99.95

EICO LR-3 "LONG RANGER" INLINE PREAME

Bring in those distant/weak signals. Boosts receiver sensitivity up to 20 db. Automatic transmit/receive switching.

EICO CM-2 "CHANNEL MONITOR" AUTO-SWITCH

Automatically silences car radio when CB call is received/transmitted.

EICOCRAFT®IC KITS

EC-5000 SCA ADAPTOR KIT **ONLY \$12.95**



Convert your FM radio or receiver to pick up the official FCC-licensed background music service (SCA). IC decoder/adaptor permits hearing uninterrupted, commercial-free music broadcast by many FM stations (For personal, non-commercial use only).

IC PROJECT KITS NOW AVAILABLE

EC-5100 ESP Tester \$10.95

EC-5200 "Decision Maker" \$9.95

EC-5400 Stereo Power Amplifier \$10.95

EC-5500 Stereo Pre-Amp \$9.95

EC-5600 Electronic Lock \$11.95

EC-5700 Universal Power Amp \$8.95

HOBBY/AUTOMOTIVE



BW-300 ALPHA BRAINWAVE MONITOR

Lowest cost, battery operated, professional Biofeedback System. IC Circuit design features an active filter and 5-microvolt sensitivity. Complete with stethescopic earphone, electrode headband and instructions

Kit \$34.95 Wired \$59.95

885 "TUNEMASTER" ENGINE ANALYZER

Automatic all-in-one test bench for all 6 or 12 volt ignitions-conventional or transistorized. Giant 6" meter with 6 color coded scales. Complete with tune-up and trouble-shooting manual.

Wired \$59.95

BURGLAR/FIRE ALARMS



SS-500 BURGLAR/FIRE ALARM SYSTEM

Professional Security System designed for easy do-it-yourself installation. Features EICO FC-100 Control Center with AC/DC automatic transfer to battery operation. Complete system includes Installation Handbook. Add additional sensors, bells, to suit your own needs. \$159.95

SD-75 BATTERY OPERATED FIRE/SMOKE ALARM

Ionization-type detector gives earliest possible fire warning. Mounts directly to ceiling with 2 screws. "Beeps" when battery needs replacement. U.L. listed.

FREE EICO CATALOG

The more you know about electronics, the more you'll appreciate EICO. Every EICO product is designed to provide you with the most pleasure and quality performance for your money The fact that more than 3 million EICO products are in use attests to their quality and performance.

"BUILD-IT-YOURSELF" and save up to 50% with our famous electronic kits.

For the latest EICO Catalog and name of nearest EICO Distributor, check reader service card or send 50¢ for fast first class mail service.

EICO-283 Malta Street, Brooklyn, N.Y. 11207

Leadership in creative electronics since 1945.



peak-indicating level meters and features an automatic overload device that protects against excessive audio input levels. The LED indicator glows when the protection circuit is activated and shuts off the energizer. Once the protection circuit is activated, it keeps the energizer shut off for 3 to 4 seconds after the excessive level drops to a safe value, \$300.

CIRCLE NO. 97 ON FREE INFORMATION CARD

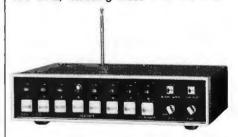
MAYCOM CB MOBILE ANTENNAS IN COLOR

Riotous Red, Lily White, Big Blue, Sand Tan, Cat Black, Down Brown, Grimly Grav, Machine Green, and Yellin' Yellow are the colors of a new line of CB "Colorwhip" mobile antennas from MavCom. The antennas and mounts can be purchased in matching or mixed colors to complement or coordinate with the vehicles on which they are installed. The patented fiberglass whips come in 4' and 6' (1.2 and 1.8 m) lengths with top-loaded, helically wound radiators, plastic sheaths, and chrome-plated brass ferrules. Prices are \$10.25 and \$11.25, respectively. No-drilling Model GW-7 trunk mounts are also available in color for \$13.45.

CIRCLE NO. 98 ON FREE INFORMATION CARD

HEATH HIGH-BAND SCANNING RECEIVER

The Model GR-1131 high-band scanner from the Heath Company monitors any combination of eight channels in the "emergency-services" public-safety band between 146 and 174 MHz, including those from the U.S.



Weather Service. The receiver scans each channel, stopping at any that is active, and resumes scanning after the transmission. A priority channel feature checks the channel in which the user is most interested every four seconds and automatically switches to it if there is activity there. Features include channel lockout buttons, lighted channel indicators, automatic/manual channel selection, and a four-pole crystal filter for good selectivity. For crowded areas, an optional eight-pole filter is available. Also featured are a built-in telescoping antenna and provision for an external antenna. Ac or 12-volt dc operation. \$89.95.

CIRCLE NO. 90 ON FREE INFORMATION CARD

AMP HAND WIRE STRIPPER

AMP Special Industries Hand Wire Stripper employs front-feed stripping action to make short wires easy to strip. A built-in sensor

THE TERMINAL YOU ASKED FOR

CT-64

- * 16 LINES 64 or 32 CHARACTERS PER LINE
- * SCROLLING ON EITHER OF TWO PAGES OF DISPLAY
- * 128 CHARACTER ASCII SET UPPER AND lower CASE LETTERS
- * PRINTS CONTROL CHARACTERS IF DESIRED
- * FULL 32 CHARACTER CONTROL DECODING
- * FULL 8 BIT MEMORY
- * 110/220 Volt 50-60 Hz POWER SUPPLY
- * COMPLETELY INDEPENDENT DESIGN—Usable with any 8 bit ASCII computer or with modem for time share applications.
- * MOLDED PLASTIC COVER MATCHING MONITOR AVAILABLE

Now you can buy it. The terminal that has all the features that people have been asking us to include. The CT-64 has all the functions that you could want in a terminal and they may be operated by either switches, or through a software program.

All cursor movements, home-up and erase, erase to end of line, erase to end of frame, read on, read off, cursor on, cursor off, screen reversal, scroll, no scroll, solid cursor, blinking cursor, page selection and a beeper to warn you of end of page; all are provided for your use in the CT-64.

You may also switch from upper case only teletype style operation to upper-lower case typewriter style operation. You can reverse the field on individual words to highlight them, or you can reverse the whole screen.

CT-64 is complete with keyboard, power supply serial interface and case. A matching 9 inch monitor with coordinated covers is also available to make a complete system.

CT-64 Terminal Kit

\$325.00

MM-1 Monitor (assembled)

\$175.00



219 W. Rhapsody

San Antonio, Texas 78216

Enclose is \$325.00 for the CT-64	4	
Send the MM-1 monitor too.	Send Data	
or BAC	#	
or MC	Ex Date	
NAME		
ADDRESS		
CITY	STATE	ZIP

Southwest Technical Products Corp. 219 W. Rhapsody, San Antonio, Texas 78216



measures the wire and adjusts the tool for optimum stripping action with minimum hand pressure. The tool is molded of lightweight plastic. Wire and cable up to #12 AWG solid or stranded can be cut and stripped by the tool. Paired wires can be stripped simultaneously. \$33. Address: AMP Special Industries, Valley Forge, PA 19482.

KEYBOARD VIDEO INTERFACE

The Merlin keyboard video interface, from MiniTerm Associates, provides ASCII characters (20 lines of 40 characters), high-resolution graphics, and optional monitor and editor functions. The two boards include a DMA controller that permits displaying any part of the computer memory. Also, since the display's starting address is software-controlled, the memory segment displayed can be changed with every screen refresh. Dense graphics will display 2k words of memory as 160H by 100V dots; sparse graphics displays



1k as 80H by 100V. Versions of Merlin for Altair, Imsai, Southwest 6800 and Digital Group computers are available at \$249.00 kit plus \$34.95 for an optional on-board 2k ROM for the monitor and editor functions.

CIRCLE NO. 99 ON FREE INFORMATION CARD

POLYTRON OP AMP DESIGNER TESTER

Designed to help both the beginner and experienced user to experiment with and test circuits containing one or two op amps, the "Dual Op Amp Designer Tester" from Polytron Devices doesn't require any soldering. Components other than op amps can be plugged in. Features include solderless tie points, two 10k potentiometers, four pairs of binding posts, four IC sockets. Model 202 with ±15-V, 100-mA dc regulated power supply is \$55; Model 201, using 9-V batteries, is \$33. Address: Polytron Devices, Inc., Box 398, Paterson, NJ 07524.

PIONEER AM/STEREO FM TUNER

Pioneer's Model TX-950011 AM/stereo FM tuner has an automatic pilot-signal canceller that minimizes 19-kHz leakage into the audio



section. Featuring both narrow- and wideband operation, it also has a SAW (surface acoustic wave) filter that minimizes adjacentchannel interference. A switch permits using the amplifier/speaker system, minus oscilloscope, to detect multipath reflections as the FM antenna is adjusted. The alternate position of this switch generates a 440-Hz signal every 1.6 seconds (equivalent to 50% FM modulation) for checking the level on a tape deck before recording off the air. Specifications include: 8.8 dBf (1.5-µV) sensitivity in mono; 13.2 dBf (2.5 μV) in mono and 36.1 dBf (35 µV) in stereo 50-dB quieting sensitivity; 77 to 82 dB S/N at 65 dBf; 20 to 15,000 Hz +0.2/-0.5 dB stereo frequency response; and 0.05% to 0.07% distortion in mono at 1000 Hz. \$400.

CIRCLE NO. 100 ON FREE INFORMATION CARD

Aircommand 40-channel CB.

From you fill filters tures plete signal passes sens

From the people who bring you Marantz—the world's finest stereo systems—

comes the Aircommand CB-640—the finest in 40-channel CB. With Aircommand you get over 25 years experience in outstanding 2-way communications products.

Full 6 Watts of audio power. Provides plenty of punch so your speaker cuts through freeway noise.

Dual-conversion superheterodyne receiver with dual-cascaded ceramic filters. Together, both features provide the most complete rejection of unwanted signals, assuring you unsurpassed selectivity and sensitivity. 4 big Watts of RF power. Aircommand delivers the maximum power legally allowable to let you belt out the big sound. 100% modulation capability. Even when you talk softly into the mike, your message cuts through loud and clear, thanks to one of the most advanced mike preamp and compressor designs in CB today. With Aircommand, you don't have to spend an extra \$30 to \$40 on a "power mike."

Specially tailored frequency response.

LED 40-channel selection display. Easy-to-read, night or day. **8-LED (light emitting diode) meter display.** Provides an easy-to-read display of SWR (standing wave ratio), modulation, and incoming or outgoing signal strength—instantly, accurately.

You can't buy better modulation than Aircommand.

Special emergency Channel 9 scan with exclusive Aircommand "beep" alert. No matter what channel you're on, a special Aircommand CB-640 circuit continuously and silently monitors Emergency Channel 9. When someone starts transmitting on Channel 9, a unique "beep" alerts you, so you can tune yourself in and give assistance.

Public address capability. The versatile Aircommand CB-640 public address package lets you (1.) Talk into the CB mike and out an exterior public address speaker. (2.) Attach a tape recorder to the auxiliary jack on the



VOLTAGE-SURGE SUPPRESSOR CROSS-REFERENCE

A new cross-reference application note, AN504A, for voltage-surge suppressors to protect power semiconductors is available. Over 175 General Electric parts numbers are listed, along with the International Rectifier replacements that are exact mechanical duplicates, including the same power-handling capability. Address: Semiconductor Division, International Rectifier, 233 Kansas St., El Segundo, Calif. 90245.

SEMICONDUCTOR TEST INSTRUMENTS

A 6-page brochure from B&K Precision describes the company's complete line of discrete semiconductor test instruments. Products featured include the Model 530 semiconductor tester with unity-gain frequency measurement up to 1500 MHz. Technical specifications provide data on in-circuit and out-ofcircuit tests, applied test currents, indicator, calibration and limiting in-circuit shunt values. Applications for each model are also discussed. Address: B&K Precision, 6460 W. Cortland Ave., Chicago, IL 60635.

GUIDE TO SOLDERING ALUMINUM

A 6-page brochure from Multicore Solders provides information on soldering aluminum. Performance information including a table on the solderability of various wrought and cast aluminum alloys is presented with application and technical data, joint recommendations and soldering techniques. Technical specifications and performance of the company's Alu-Sol 45D are also discussed. Address: Multicore Solders, Westbury, NY 11590.

CB ANTENNA CATALOG

A new catalog SP-4 from Antenna Incorporated describes its line of Citizens Band antennas and accessories. Specifications are provided for each base and mobile antenna with similar styles listed together for easy reference. Replacement parts and accessories are also included. The catalog, Form SP-4, is available from Antenna Incorporated distributors.

VOLTAGE DROP MEASUREMENTS

"Forward Voltage Drop Measurements" is the title of Tech Tips 4–6 from Westinghouse. The 3-page article, written to assist in making accurate measurements on power diodes and thyristors that can be used as a quality control check or matching criteria for operating devices in parallel, utilizes a simplified diagram of a test circuit and explains ways to avoid inaccurate measurements caused by pulse widths, duty cycles, peak currents, mounting and measurement techniques. Address: Semiconductor Division, Westinghouse Electric Corp., Youngwood, PA 15697.

EXACT REPLACEMENT GUIDES

Thordarson Meissner, Inc. offers two new cross-reference replacement guides for CB radios and TV sets. "TV Replacement Parts Guide" Form TVPG 9 and "CB Replacement Parts Guide" Form CBRG 2 include 127 new exact electronic replacement products recently made available by the company, Guides are available from Thordarson distributors.

WIRE-WRAPPING AND TOOL CATALOG

Catalog 36G is the new 58-page catalog from O.K. Machine and Tool Corp. which describes its line of Wire-Wrapping tools and machines. Additions to the line, including circuit boards, closures and instrument cases, are described; an illustrated section explains the technology of Wire-Wrapping. Address: O.K. Machine and Tool Corp., 3455 Conner St., Bronx, NY 10475.

.You never heard it so good!!!

CB-640 rear panel, and boom your tape out through the same external speaker. (3.) Mix your voice from the CB microphone with the program material on the tape recorder. Both voice and tape sound at the same time through the external speaker. (4.) Beam your received signal through the external speaker.

Built-in standing wave ratio circuitry. Measures the efficiency of the antenna system for optimum performance.

Other outstanding features include: Delta fine tuning control, digital synthesizer with phase-locked loop,

automatic noise limiting switch, noise blanking switch, squelch control, RF gain control.

Also available: Aircommand CB-140; Aircommand CB-340. All 3 units bring you state-of-art design, flawless craftsmanship and day-in, day-out reliability. Try them out now at your Superscope Aircommand dealer.





© 1977 Superscope, Inc., 20525 Mordholf St., Chalsworth, CA 91311 Prices and models subject to change without notice.

17



Stereo Scene

By Ralph Hodges

THE DECONTAMINATION SQUAD

OR THE PAST few months (whenever I've remembered to), I've been asking people how they care for their phonograph records. Their replies have been highly individualistic. On the one hand we have the manic camp, systemized to the point where they feel vaguely uncomfortable listening to a record that has not been put through an elaborate cleaning ritual, whether they can hear any noise or not. (I number myself among this group.) At the other extreme are those joyous devil-may-cares who may blow on a disc several times (quite ineffectually, no doubt) as they carry it to the turntable, but otherwise hardly give the matter a thought.

In my circle, almost everyone who takes records seriously owns some sort of cleaning appliance for them. Velvetor plush-covered pads and specially designed brushes are common (choice of pad or brush seems to depend on intui-

tive "feel" for the cleaning process), as are Dust Bugs and similar devices. These may or may not be used religiously. I have seen some Dust Bugs so begrimed that their use would probably be a hazard rather than a help to the condition of any decent record, so the benign-neglect approach is not always inappropriate.

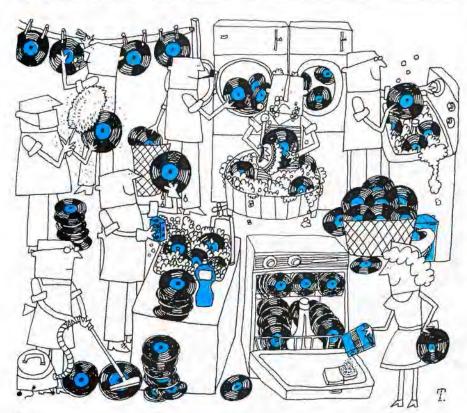
Ask the Experts. Why, after all these years, is record hygiene still a matter of guesswork rather than science? The question would be a fascinating one if its answer weren't so obvious. Ask the phono-cartridge manufacturers, whose interest in properly maintained records is readily apparent: "You know, we've always been meaning to look into that. We use the Whatchamacallit, or at least there's one at every testing station, and it seems to do okay. But then again, in the absence of a suitable control sam-

ple . . ." Ask the record companies: "All our records are clean and defect-free when they leave the plant, and with reasonable care . . ." In other words, no one—or at least no one who doesn't intend to manufacture a record-cleaning device of his own—has the time to undertake the research necessary. And no wonder, because when you think about it, such a research project turns out to be fairly formidable.

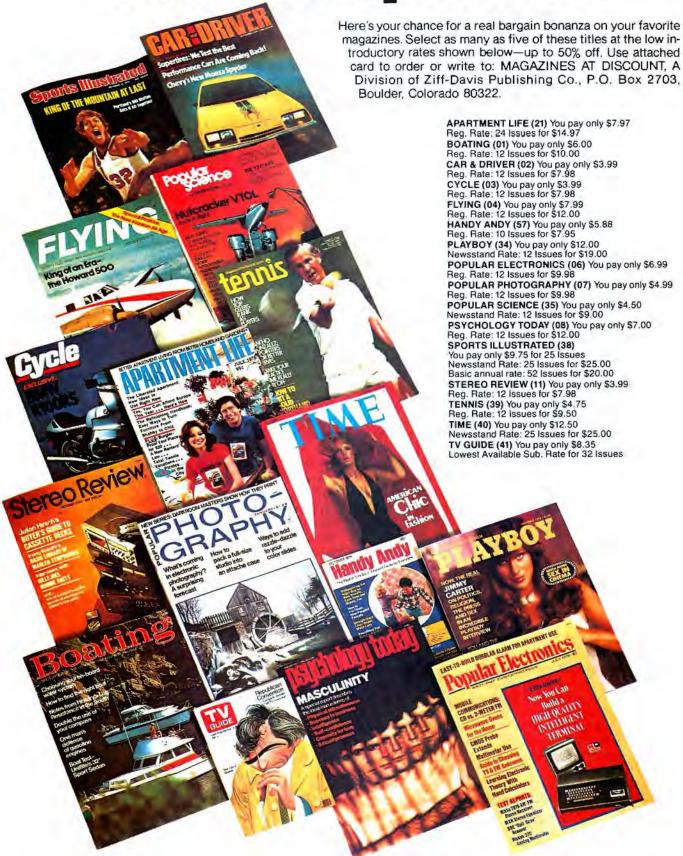
A few hardy types, including some of my eminent colleagues in the press, have made veomanly attempts to settle the issue in the laboratory. Their tests have generally taken two forms. The first is to play the dirty record, count (somehow) the number and severity of the ticks and pops presumably caused by dirt, then clean the record with the device under test, and play it again to note the improvement, if any. The trouble here is that the very process of playing a record alters its noise content. According to theory, certain dust particles will become embedded in the vinylite material by the stylus pressure-embedded too firmly for removal by any practical cleaning device. Hence the cleaning device under test faces the handicap of working with a record that has already been damaged by being played when dirty. But then, if you go on to play the record several more times, the severity of the "tick" caused by the embedded particle may abate considerably, as repeated passages of the stylus smooth the blight on the groove wall. Play the record with a different stylus and the "tick" may disappear altogether, because the stylus rides lower or higher in the groove.

Testing approach number two involves the visual inspection of the dirty and cleaned record with a high-magnification device such as a scanning electron microscope. Here the problem is that on one hand, you can't be sure that what you do see will cause noise. (Certain particles will be nudged aside or missed by the stylus.) On the other hand, what you can't see may cause noise. (An invisible residue of the cleaning agent may gum the stylus and/or raise the base noise level.) Also, there is the considerable drawback of the time involved in examining the whole record-or even a significant portion of itwith high magnification. And time is critical, because with each passing moment the record acquires a little bit of new dust.

Common to both tests are such quandaries as how do you manage to use the cleaning device consistently (most of



MAGAZINES AT DISCOUNT! You SAVE up to 50%



them are hand operated), and how do you establish an adequate control sample of the record. It has been shown repeatedly that "identical" pressings of the same record are far from identical to the stylus and the record-playing environment. According to one theory, the viny-lite material of a record takes on a molecular "set" when it is molded, so that the entire disc—or certain random sections of it—acquires a permanent static charge. If the charge distribution varies from pressing to pressing (as it logically should), you have no hope of getting identical pressings.

The Mechanism of Dirty Discs.

The laboratory is revealing but not always authoritative about the recordcleaning question. The reported experiences of long-time record users are valuable but difficult to verify. At this point we need a working hypothesis of how records get dirty so that we can consider what *ought* to be done to get them clean again. Surprisingly, there is no universal consensus on the "mechanism" of dirty discs, but here is the theory to which I generally subscribe.

First, there are airborne particles. These settle on the record as they settle on everything, and remain there unless disturbed. Perhaps they are attracted and held in place by some "net" static charge molded into the record. Then there is grosser debris, from the jacket liner or the turntable mat. This is highly visible and hence disturbing, but most of it is too big to penetrate the record grooves and thus is probably harmless. However, its persistent presence suggests that smaller, invisible bits lie within the grooves themselves.

Next comes the record-playing process, which nicely parallels the workings of a Van de Graaff generator. The intimate contact of stylus and groove (much more intimate with the superior tracing and tracking of today's cartridges) builds up some surface voltages on the disc that are probably quite impressive. These are local charges, but they apparently cooperate with any net charges present in various ways. With your record cleaner you can drag a dust particle some inches away from its location on the record surface, only to have it break free and skip back to its precise point of origin.

When the record becomes surfacecharged it acts on dust, certain colloids, and anything else available just as an electrophorous acts on a pith ball. The charges give rise to three noise-producing mechanisms. First, they hold dust motes in place where they can be played by the stylus and pounded into the vinyl. No casual puff of breath or swipe of record cleaner will effectively dislodge them. Second, they create noises-sometimes quite alarming ones-in themselves, by freely discharging through the phono cartridge. Cartridges and arms differ in their susceptibility to this, but in a dark room you can often see sparks generated as a record is played, accompanied by loud "bam" sounds through the speakers. In milder cases the static discharges are virtually indistinguishable from noise created by dust contamination.

Third, the colloids attracted by the charges often build up to form a tar-like coating on the grooves that interferes with tracing and ultimately gums up phono styli. The irreplaceable Percy Wilson studied the atmosphere's content of such substances and their effects on discs. Ponder his results for a few minutes and you'll begin to sense the onset of black-lung disease.

On to the Bizarre. More recently, Bruce Maier of Discwasher has documented the effects of fingerprints (always to be avoided) on records, and also raised the subject of certain fungi that subsist on vinylite and that are actually encouraged by the use of some record-cleaning solutions. I was not at all impressed by Dr. Maier's ideas until, several years ago, I visited Singapore. one of the brisker hi-fi markets of today and, being a mere ninety miles from the equator, a miasma of heat and humidity. There, in the home of a prominent audiophile, I saw my first-heaven help us!-green record. According to my host, the algae-like growth forms within a few days. He takes his records to the washroom and uses soap and water to combat it. (I noted few other green records in Singapore, so perhaps he was doing something Dr. Maier wouldn't have approved of.)

Getting wet. Many record listeners (Singaporeans excepted) endorse a high-humidity environment as being ideal for the static problem. They place open jars of water beneath their turntables' closed dust covers, or spend a fortune on a large and quiet humidifier. I advise against this. My first reason (another will be discussed later on) is obvious: rust! Back when I could manage long vacations, I summered in a little cottage not twenty-five feet from a quiet seaside harbor. Hardly two years had passed before my tonearm (a cring-

ingly expensive model) began to show characteristic brown stain creeping out of its pivot housing. Most of the arm was aluminum, stainless steel, and/or chrome plated. Unfortunately, the pivot bearings weren't (and few are, for excellent reasons).

Some record-cleaning devices deliberately apply a moisture slick on the record surface and let the stylus plow through that. If there's anything wrong with these appliances (aside from the above) it's hard to detect. In the opinion of some, the stylus cantilever acts as a wick to draw fluid up toward the cartridge. I've never heard anyone complain about this, however. Perhaps what's most suspicious is that the "wet cleaners" tend to remove all noise, including that which is molded into the record as groove imperfections. This effect has been ascribed to surface tension. viscosity, and the fact that sound wavelengths are different in water than in air. Or perhaps it's simply a function of the fluid's lubrication. No one seems to know for sure, but a significant number of audiophiles-particularly those with overbright systems-seem to swear by wet playing.

The Author's Approach. I suspected you were interested in my own record-cleaning techniques, and I thought you'd never ask. With the record rotating on the turntable, I begin with an antistatic device such as the Discwasher "Zerostat" pistol, which produces clouds of positive and negative ions when the trigger is squeezed or released. This treatment is simply to release the debris particles being held by static charges, which then can be scooped up by a velvet or plush cleaning pad. (Some claim that such a pad won't scoop unless its bristles are slanted, but my experience suggests that a curvature in the contour of the cleaner accomplishes the same thing as a slanted pile). A little moisture will help the dust particles adhere to the bristles, and I am indebted to a reader for pointing out that open-mouthed breathing on a record will lightly fog it with condensed pure water vapor. So I breathe on the record as I brush.

As the record plays I use a device similar to a Dust Bug, but with a difference. Some years ago, at the height of a very humid summer (remember the objections raised to humidity earlier), I came up against an unaccountable, steady "thththth" sound on a record I knew was intrinsically good and well cared for. What?! Could it be static, encouraged by the high humidity to dis-



IT'S WHAT YOU GET WHEN YOU RUN WITH NUMBER 1.

For 1977, Midland gives you the power to communicate. To reach out beyond your personal horizon.

In an entire new generation of Midland 40-channel CB radios, spearheaded by the remarkable Midland 838.



CIRCLE NO. 37 ON FREE INFORMATION CARD

The 838 features switchable automatic noise limiter, noise blanker and audio filter. Plus an automatic channel advance and volume control right on the mike, and a big, bright L.E.D. digital channel indicator.

But the 838 is only one of Midland's '77 CB line, which includes eighteen very comfortably priced basestation, mobile and portable 40-channel models.

All backed by Midland's 15 years of CB experience, Midland's warranty and convenient service centers, coast to coast.

No wonder we sold over 2 million Midland CB's last year, making us the world's number 1 CB brand.

Midland Power. It's what you want from a CB. It's what you get when you run with number 1.



AIDLAND CE

A member of the Beneficial Corporation Family.

Shop for these active-living products from Midland International: Medallion Car-Sound Products • Goodwin Sporting Goods • Benchmark Tools • Midland Televisions • Young World Toys



It sounds an alarm. A built-in alarm that's set off any time—
night or day—when severe weather threatens.
The alarm is triggered by a signal from your local National
Weather Service transmitter. After it sounds, a report on the
danger and survival instructions come on.

When conditions are normal, the Storm Alarm picks up the weather station's continuous, up-to-the-minute

forecasts.

Unlike ordinary weather radios, which the user must monitor, the Storm Alarm continually monitors itself. The alarm sounds full blast whether or not you have the volume turned up and are listening. You're warned even when sleeping. Crystal-controlled and switch-selectable.

Superior reception from

as far out as 40-50 miles. Works on AC. Built in back-up battery feature. 25" telescoping antenna. 21/4" speaker. Unit only 3" x 5" x 11/4."

With all these features, it's no

With all these features, it's no wonder a leading electronics magazine called the Storm Alarm a "sensitive weather receiver and, for a relatively low price, an excellent disaster alarm."

Get the Storm Alarm. It's a foul and fair weather friend.





Illinois residents and 5% sales tax. Alaska, Hawaii, Puerto Rico residents add \$2.50 per unit for special shipping and bandling. Not available in Canada.

charge through the cartridge in a rather relaxed fashion? Within ten minutes I had acquired one of the record-tracking/ cleaning devices that has conductive bristles intended to be grounded at the tonearm or preamp input. To my fascination, I found that the annoying sound disappeared within a few moments of my lowering the bristles to the record surface, and reappeared a few moments after I had raised them. Needless to say, I held onto this contraption, and it has been doing a fine job ever since. This is my idea of how to clean records; I welcome comments.

As long as this article has been, it has left out some pertinent points: the how and whys of stylus cleaning; the efficacy of the new friction-reducing record sprays; the "dust-bug" brushes that come attached to cartridges; the reason some records seem to be more staticprone than others; and the ways in which cartridge/tonearm choice and alignment can effect the annovance factor of record noise (they can, apparently). I don't have firm responses to any of these (implied) questions, but I do have opinions, which will be forthcoming later on. In the meantime, let me give you several warnings:

(1) Don't rashly buy a record cleaner meant to be used while the record is playing if your turntable has limited torque, as many belt-drive units do. Dust-Bug-type devices are usually okay, but the ones that span an entire LP radius or which are driven off the turntable itself may make it impossible for your record player to get up to speed.

(2) Don't use the turntable's dust cover as a record cleaner. Laboratory tests have shown pretty conclusively that many dust covers provide an excellent path for acoustic feedback. Keep the cover removed or at least raised when you play a record. It is meant only to keep the turntable clean when it is *not* in use, and I don't know of any responsible turntable manufacturer who claims that it is otherwise.

(3) Experiment with anything meant to be applied to a record cautiously. All solvents and even distilled water are suspect with many, although they are beloved by some. When you feel you must evaluate a record-treating substance, dose one half (180 degrees) of a good record with the stuff and leave the other half untreated. At 33 1/3 rpm you should be able to detect the transition from the one side to the other (at 45 rpm things may happen too fast). And be prepared to buy a new record just in case your experiment doesn't work.

◊

Speakers are our only business. They have to be better! Designed with security and superior sound in mind, the AFS / KRIKET KAMEL KC-3085 humpmount external speaker rests snugly on the transmission hump while driving. CB dials are readily visible. CB transceiver mounts on speaker base forming single unit. No installation problems. For maximum security, unplug antenna and power leads, lift unit and place in trunk. No screws to unscrew. No hassle. No annoying rattles while driving. Solid! "WORKING WALL" enclosure of cross-laminated fiberboard deadens static and channel noise, ell Available at CB dealers everywhere voice distortion. AFS makes having an expensive CB rig in your car of truck safe and worthwhile. Isn't it about time somebo Kriket Cares ACOUSTIC FIBER SOUND SYSTEMS, INC. 7999 KNUE ROAD, SUITE 116 INDIANAPOLIS, INDIANA 46250 (317) 842-0620 Canadian Distributor Muntz Canada Ltd. 1149 Pioneer Road Burlington Ontario, Canada (416) 639-5373 All AFS®/KRIKET® speakers are manufactured in the U.S.A. using American materials and craftsman. Copyright 1976 Acoustic Fiber Sound Systems, Inc.

Julian Hirsch



Audio Reports

IOW HEADPHONES ARE TESTED

ANY PEOPLE are aware, at least in general Merms, of some of the effects that room reflections and resonances have on the perceived frequency response of a loudspeaker. For example, the bass response varies widely as one moves about the room, usually being strongest at an opposite wall or corner or close to the woofer, and weakest in the center of the room. High frequencies, on the other hand, are progressively absorbed by room furnishings as one moves away from the speaker. High-frequency level can also change greatly at different angles between the listener and the speaker.

There are ways to circumvent these problems, and even put them to good use, when measuring loudspeaker performance. Most designers, though, choose to test a speaker in an anechoic chamber (a room whose interior surfaces absorb essentially all sound impinging on them, and reflect little or nothing to a microphone placed in the chamber). In this way, the characteristics of the speaker can be determined, free from interaction with its surroundings.

In the case of headphones, the audible results are closely related to the dimensions of the wearer's ear cavity, and the manner in which the earpieces fit the pinna or external ear. These are analogous to the relationship of the room to the loudspeaker. Although anechoic measurements might be possible with headphones, they would be of little practical value since the ear affects the frequency response through the entire audio range.

It is possible to measure headphone response directly on a human head by means of probe microphones inserted into the ear cavity. This is valuable for psychoacoustic and physiological studies, but clearly is of no use to someone wishing to evaluate a headphone. It would be convenient to have a "standard ear," on which any phone could be checked. Even if such an ear were not identical to any specific human ear, it would provide a test bed on which to make comparative headphone measurements.

There are standard artifical ears—several different types, in fact. Some have been shaped to correspond roughly to the external human ear, but others merely present a flat surface to the headphone's ear cushion, with a cavity drilled in the center to expose the end of a calibrated capacitor microphone that simulates the eardrum. This is the basic configuration of the ANSI standard headphone coupler, which we use in slightly modified form for our headphone tests.

The original purpose of the standard coupler was to measure headphone response in the speech frequency range (300 to 5000 Hz). It was recognized that resonances in the coupler cavity would produce severe response changes at higher frequencies. The standard coupler has a 6-cc cavity, simulating the volume of a typical ear. The shape of this cavity is subject to slight modification to suit the particular

type of headphone being tested.

Experiments made by Koss Electronics indicated that a good correlation between measured frequency response and the subjective headphone response would be achieved with a slight modification of the shape of the coupler cavity (keeping its volume at the standard 6 cc). The Koss coupler, which we use for our tests, conforms to the 1949 ANSI standard, except for the details of the cavity shape. It is a flat plate coupler into which our test microphone fits snugly. When the headphones are mounted on the coupler stand, the normal tension of the headband provides sealing around the ear cushion of the measured earpiece, equivalent to what would exist with normal wearing.

Although the Koss coupler makes it possible to measure headphone frequency response through the full audible range, it has a few intrinsic high-frequency resonances that make measurements less reliable above 10,000 Hz. Our coupler has been calibrated by Koss, with the aid of a calibrated set of its ESP-9 electrostatic phones. This enables us to check the performance of the test set-up and also provides an absolute calibration of sound pressure level (SPL), since the output of the ESP-9 phones is known at a particular

frequency and drive level.

To measure the frequency response of a headphone, it is placed on the coupler and driven from an amplifier whose input is derived from our General Radio frequency-response plotter. The microphone output goes directly to the graphic level recorder input, and the chart reads out directly in dB on the SPL scale (referred to 0.0002 dyne/cm2). The voltage across the phone is set to a value recommended by the manufacturer (usually in the range of 1 to 3 volts) and a swept response measurement is made using a fast chart speed (25 inches per minute) and moderate pen damping (pen speed, 3 inches per second) to smooth out small variations caused by the coupler.

Distortion is measured at 1000 Hz as a function of applied voltage. The microphone output goes direct-



Fighting a fire takes tough men. And tough equipment. Equipment like the Motorola® 2-way radios carried by so many fire fighters.

Today you can own a 2-way radio with many of the engineering principles that go into Motorola professional radios.

You can own a Motorola CB.

Features like gain control, audio compression, and noise limiting are built in, fully automatic.

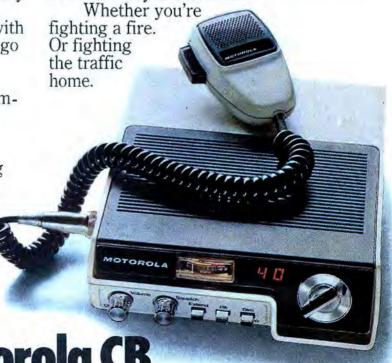
So a Motorola CB is exceptionally simple to operate. Yet offers outstanding talk/listen performance.

A top-fire 3½-inch professionalquality speaker produces an audio fidelity that must be heard to be fully

appreciated.

A power mic that doesn't require batteries, that doesn't cost extra, is standard equipment.

When you've made 2-way radios as long as Motorola, the result is a radio with a difference you can hear.

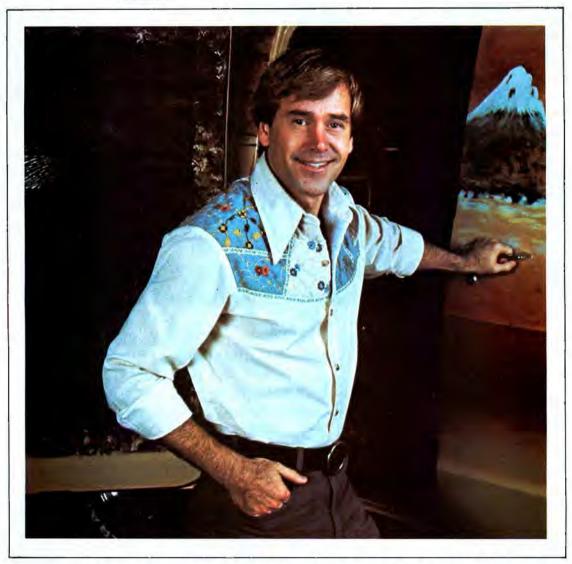


Motorola CB

From the voice of experience in 2-way radio.



You gotta shop around.



When you do, you'll probably pick CIE.
You can't afford to settle for
less when it comes to something like
electronics training that could
affect your whole life.

hen you shop around for tires, you look for a bargain. After all, if it's the same brand, better price—why not save money?

Education's different.
There's no such thing as "same brand." No two schools are alike. And, once you've made your choice, the training you get stays with you for the rest of your life.

So, shop around for your training. Not for the bargain. For the best. Thorough, professional training to help give you pride and confidence.

Se Se Se

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Why you should shop around yourself.

We hope you'll shop around. Because, frankly, CIE isn't for

everyone.

There are other options for the hobbyist. If you're the ambitious type — with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you

can do - and on how well you do it. A

Here are ways some of CIE's trouble-shooting programs help you get your "hands-on" training...

With CIE's Experimental Electronics Laboratory... you learn and review the basics perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!



When you build your own 5 MHz Triggered-Sweep, Solid-State Oscilloscope you take your first real professional step. You use it as a doctor uses an X-ray machine—to "read" waveform patterns...lock them in... study, understand and interpret them!

When you get your Zenith 19-inch Diagonal Solid-State Color TV you

Pattern simulated.

apply your new skills to some real on-the-job-type trouble-shooting! You learn to trace signal flow...locate malfunctions...restore perfect operating standards—just as with any sophisticated electronics equipment!

When

you work with a completely

Solid-State Color

Bar Generator—
actually a TV signal
transmitter—you study
up to ten different
patterns on your TV
screen... explore digi-

tal logic circuits...observe the action of a crystal-controlled oscillator!

Of course, CIE offers a more advanced training program, too. But the main point is simply this:

All this training takes effort. But you'll enjoy it. And it's a real plus for a troubleshooting career!

Do you prepare for your FCC License?

Avoid regrets later. Check this out before you enroll in

any program.

For some troubleshooting jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of specific knowledge and skills!

More than half of CIE's courses prepare you for the government-administered FCC License exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

Shop around...but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, men-

you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to answer your questions.

Mail the card or coupon—or write: CIE, 1776 East 17th St., Cleveland, OH 44114.

Proposition (Charles Constitution)	veland, Ohio 44114 ome Study Council
☐ YESI'm	shopping around
for the right kind o	f career training
in electronics troub CIE sounds well wo	leshooting – and
Please send me my	FREE CIE schoo
catalog - including	details about
troubleshooting cou	rses-plus my
FREE package of ho information!	PE-34
Print Name	
Address	Apt.
City	
	Ztp
State	
State Age Phone	

ly to a Hewlett-Packard 3580A spectrum analyzer, on which all significant harmonic amplitudes can be measured. Impedance is measured by driving the phones through a fairly high resistance and plotting the voltage across them on the chart recorder. The resistance axis of the recorder chart is calibrated against a precision standard decade resistor, substituted for the headphones.

Interpreting the frequency-response curve of a headphone measured in this way is not as easy as we would like it to be. Sometimes the response is relatively flat over most of the audio range, and this is always associated with a phone which has a smooth, natural sound. Sometimes there will be one or more huge peaks (as great as 30 dB in amplitude) in the upper midrange. Such a phone always sounds harsh and unnaturally colored. The difficulty is in the intermediate cases, which comprise the majority of

phones. Their response curves often have rather sizable peaks or holes in the range of a few kilohertz. These cannot easily be separated into true headphone response and the coupler response. Many of these phones sound excellent, virtually indistinguishable from some which test much better, while others that are seemingly not too different sound mediocre.

Thus, as with speakers, the only way to buy a headphone is to listen for yourself. With headphones, you have the advantage that the listening room is not a part of the equation, so the phones will sound the same in your home as at the dealer's showroom. Since the physical "fit" of a headphone can be as important as its sound, a personal selection is highly desirable. Test reports can be a guide to those phones that are worthy of your consideration, but response curves should never take priority over the judgment of your own ears.





SENNHEISER MODEL HDI 434 INFRARED HEADPHONES

Cordless headphones provide unfettered personal listening.





With these innovative, cordless, stereo headphones, the listener can be free

at last from the tether that attached him to the headphone jack. In the past, most attempts at designing cordless hi-fi headphones failed to meet the high quality sound needs of the home listener. The various cordless approaches tried were plagued by poor sound quality, high noise levels, and inability to handle stereo program material. The new Model HDI 434 infrared stereo

phones from Sennheiser have solved most of the technical problems.

The Model HDI 434 is actually a headphone "system" that consists of rather large (but lightweight) phones and a separate infrared transmitting unit. No physical connection is needed between the phones and transmitter, nor are there antennas or other appendages on the phones themselves. The only link between the phones and the transmitter is an invisible infrared beam. The transmitter plugs into the headphone jack of any amplifier, tuner, or tape deck.

The infrared transmitter measures

 $8\text{''W} \times 3.15\text{''D} \times 0.7\text{''H}$ (20.3 \times 8 \times 1.8 cm), and the headphones weigh 13.5 oz (420 g) including battery. Prices: \$209 for the Model HDI 434 phones and \$184 for the SI 434 infrared transmitter.

General Description. The earcups of the headphones house magnetic open-air drivers. The earcups are designed to provide little or no isolation from external sounds. The semirigid headband has a padded adjustable inner band that rests on the user's head.

On the rear of the right earcup are a pair of slide-type controls for separately adjusting the volume levels in the two earcups. A slide-type switch allows selection of normal stereo listening, channel-A mono through both earcups, or channel-B mono through both earcups. A separate switch controls power to the headphones from its own 9-volt battery. The left earcup has no controls; it houses the battery that powers the phones. A clear plastic on the front edge of the right earcup protects an infrared sensor that picks up the invisible beam radiated by the transmitter.

Across the front panel of the transmitter is a row of 12 light-emitting diodes (LED's) that generate the invisible infrared carrier beam. A separate LED, located at the far left of the panel, is used as the power-on indicator for the line-powered transmitter. The pushbutton power switch is located at the far right of the front panel.

You may have noticed that few turntable manufacturers call your attention to the critical role of the tonearm in record playback. Dual is an exception.

Whatever the shape, materials, or mechanics of a tonearm, the goal is always the same: to maintain the cartridge in the correct geometric relationship to the groove, and to permit the stylus to follow the contours of the groove

Why we want you walls freely and accurately. Whenever the stylus cannot follow the groove to know more about undulations, it will gouge its own way. And as we have tonearms. And why frequently reminded you, there is no way to repair a damaged others may not record. Every tonearm designer should consider record. Every tonearm de-

geometry, mass, balance, resonance, bearing friction, and the accuracy and stability of settings for stylus force and anti-skating. However, despite the simple fact that the shortest distance between two points is a straight line, some designers are more concerned with appearance. Hence, the curved tonearm, whose deviations between pivot and stylus simply add mass, reduce rigidity and increase the likelihood of resonance.

Dual engineers have always designed for optimum performance. The essential differences in approach and results are indicated below. You might keep all this in mind when you are considering your next turntable. Chances are you'll want it to be a Dual.

United Audio Products, 120 So. Columbus Ave., Mt. Vernon, N.Y. 10553

Exclusive U.S. Distribution Agency for Dual

The curved tonearm may appear longer than the Dual tonearm, but both actually have the identical effective length and horizontal tracking angle.

Actual size of Dual tube (A) and typical curved tonearm (B). For the same effective length, straight Dual tonearm has lower mass and resonance, yet greater rigidity.

Dual 1249. Single-play/multi-play. Bell-drive Fully automatic start and stop, plus continuous repeat. Mode Selector parallels tonearm to record in single play; 6% pitch control; illuminated strobe; cue-control viscousdamped in both directions: multi-calibrated antiskating. Less than \$280. Dual 510, Similar except

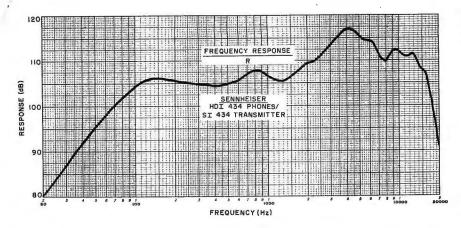
groove sensor Tonearm lifts automatically at end of play and motor shuts off. Less than \$200 Dual 502. Semi-automatic. Less sensar,

harizontally and vertically on identical

Stylus force, applied by long coiled perpendicular to record even if turntable is not level.

sets of pivat points and high-precision low-friction bearings. Bearing friction: vertical, <0.007 gram; harizontal, < 0.015 gram.

Specifications (DIN B): Rumble, ≥66dB; Wow and flutter, <±0.05%



Overall frequency response of headphones and transmitter.

In operation, the transmitter is placed in a location where its beam will cover the preferred area of the listening room. Then, with the headphone worn in the usual manner, the stereo program is heard just as with conventional headphones. The big difference here is that the listening volume is set by the slide controls on the right earcup.

It is important to have a sufficient, but not excessive, modulation level driving the transmitter. This is accomplished by turning up the volume control of the audio component that drives the transmitter until the glowing LED on the latter suddenly begins to flash, and then backing off slightly until the flashing just ceases. Thereafter all volume level adjustments are made by operating the controls on the phones.

The stereo program is carried over the infrared beam on two subcarrier frequencies—95 KHz for the left channel and 250 kHz for the right channel. The specifications call for a 30-kHz deviation at 1-volt input to the transmitter and 50-kHz deviation at the 1.5-volt maximum allowable input. The headphones contain two FM discriminators that are tuned to the subcarrier frequencies and are capable of demodulating signals with deviations as great as 50 kHz.

The specifications for the phones call for a frequency response of 20 to 20,000 Hz (no tolerance given) with less than 1% THD at 1000 Hz (at an unspecified level) and a maximum output capability of 108 dB SPL. The S/N ratio is rated at approximately 60 dB, and estimated operating life of the standard 9-volt battery is 100 hours.

Laboratory Measurements. We tested the acoustic performance of the phones on a modified ANSI headphone coupler in the usual manner. The transmitter was placed a few feet from the

headset and driven directly from our General Radio response plotter. Having determined that a 1-volt drive level to the transmitter resulted in spurious "birdies" at frequencies beyond 12,000 Hz, we reduced the drive to 0.5 volt for the response measurement.

The midrange response was very flat, varying only \pm 1.5 dB from 100 to 1700 Hz. The output rose at higher frequencies and was at or above the midrange level all the way up to our measurement limit of about 16,000 Hz. The low-frequency output, as is usually the case with open-air headphones, dropped off at a 12 dB/octave rate below 100 Hz. The midrange SPL was about 105 dB, or 111 dB at the recommended maximum operating level of 1 volt.

The overload indicator glowed at a 1.15-volt input with frequencies of 1000 Hz or lower. Overload occurred at smaller signal voltages at high frequencies, reducing to 0.43 volt at 10,000 Hz and 0.32 volt at 15,000 Hz. The distortion of the acoustic output of the headphone was less than 1% for drive levels up to about 1 volt at 1000 Hz. With the phone's volume controls set to maximum, the distortion increased abruptly above about 1.2 volts. This was apparently due in part to overdriving the headphone amplifiers, since reducing the setting of the volume controls by 10 dB resulted in a more gradual increase in distortion, to 2% at 1.8 volts and 3.4% at 3 volts. Distortion is not a problem when using the phones, since it became appreciable only when the SPL exceeded a very loud 110 dB.

The S/N was measured relative to the output at 1000 Hz with a drive level of 1.15 volts. Wtihout weighting, the S/N was 40 dB, and with CCIR weighting it was 54 dB. The stereo channel separation reduced with increasing frequency, from 40 dB at 100 Hz to 21 dB at 3000

Hz. It remained in the 18-to-21-dB range from 3000 to 15,000 Hz. The electrical impedance of the transmitter input was 100,000 ohms up to about 1000 Hz. It decreased to between 13,000 and 25,000 ohms in the 10,000-to-20,000-Hz range.

User Comment. Considered only as stereo headphones, we would rate these on a par with other Sennheiser phones we have tested. They are excellent, producing a clean, wide-range, transparent sound that could not be distinguished from conventional phones.

The listening volume was most satisfactory, and we heard no background hiss or other noise that was not in the program material. In other words, the

Editor's Note: The listening experience with these infrared phones may differ according to the environment and the placement of the transmitter. For example, using the same new Sennheiser phones in a large (25 ft × 19 ft × 8 ft) wood-paneled listening room in the editor's home, a person standing in front of the transmitter or the headphone wearer did not change the sound quality received by the phones when the infrared transmitter was positioned near the corner of the room (a position also tried during Hirsch-Houck tests). Furthermore, in this position, headphone reception was not at all marred by noise when turning a head or even one's back so that the phone receiver's single sensor was facing away from the transmitter. Nor was there any change in sound when a cigarette lighter was flicked, a pipe lighted, or pipe smoke blown by the headphone user. Moreover, the signal-to-noise ratio did not even exhibit an apparent change when the user walked into a hallway off the listening room so that he was behind the transmitter. Turning one's head in this area, however, did cause a high level of noise to occur, as did standing under a strong spot-

It should be mentioned, as a footnote, that this listening room has angled ceilings emanating from four-foot-high paneled walls and rising to a flat plasterboard ceiling surface. In contrast, Hirsch-Houck's ceiling is constructed with acoustic panels. These differences evidently account for the contrary results in infrared reception. It's obvious that, in the editor's home, the environment enhanced reflections of the infrared beams. As a consequence, the performance of these infrared stereo phones was superb with no reservations whatsoever.



Ask a trucker about the best antenna team for your CB operations. He knows the Citizens Band. And he knows the performance of Shakespeare's Double Trucker Antenna. Because the men who ride for a living can't settle for anything small-time in their signal power.

Those two solid fiberglass whips stand firmly upright for maximum range and clarity. Perfectly co-phased through Shake-speare's exclusive Diplexer phasing harness. Pre-tested and pre-tuned for the 40 channel band. Delivering the kind of performance true Knights of the Road depend on.



S/N of the infrared system was at least as good as that of the FM and commercial phonograph records we used for program sources.

The transmitter evidently radiates a fan-shaped pattern into the room, which does not reflect from room boundaries to any significant extent (unlike ultrasonic remote-control devices, whose output can be "bounced" off a wall to reach around a corner). This means that the phones must be in a direct line of sight with the transmitter, although distance does not seem to be a problem. (We covered 30 feet or more without difficulty.) However, if someone walks between the listener and the transmitter, the sig-

nal drops markedly or disappears altogether, delivering a burst of noise like that of an unmuted FM tuner when the signal drops out. Interestingly, a crackling sound occurred when the listener flicked a flint-type lighter, followed by noise when the lighter's flame appeared.

If one turns away from the transmitter, or even to the side so that the left ear is closest to the transmitter, however, a loss of signal is likely to occur. We found this in some ways to be restrictive, although one quickly adjusts to the minor limitation. This occurs because the receiver sensor is on the front of the right earpiece. The answer, it would seem, would be to either place a sensor on

each earpiece or mount a single one at the top of the rigid headband to prevent shadowing of the receiver as the wearer moves or turns.

Aside from the above, we were highly impressed with the concept used by these phones, as well as its execution. The system does a remarkably fine job without excessive weight or bulk. True, they are among the most expensive headphones you can buy, but they also do things that no other phones can. One simply has to experience the wonderful feeling of not being tied down to a headphone's umbilical cord to appreciate it. And, the sound is truly superb.

CIRCLE NO. 101 ON FREE INFORMATION CARD

TEAC MODEL PC-10 CASSETTE RECORDER

Portable stereo recorder has performance characteristics of home component types.





The Model PC-10 portable cassette recorder is part of Teac's new "Esoteric" line. It is one

of the new breed of true high-fidelity portable stereo recorders with all the features and performance quality expected of deluxe home cassette decks. It comes with a separate ac power supply for line operation and can be operated in the field from six D cells that fit within its case.

The recorder measures 11½" W \times 9½" D \times 3½" H (29.2 \times 24.1 \times 8.9 cm) and weighs 11 lb (5 kg). Nationally advertised value is approximately \$500.

General Description. The recorder features a direct-drive dc capstan motor that is servo-controlled through a phase-locked loop (PLL). This eliminates belts and flywheels; it starts up and brings the transport to final operating speed rapidly. (There is a separate dc motor for the tape hubs.) The PLL motor drive makes the recorder's operating speed relatively

independent of supply voltage and temperature, the latter specified over a range of 32° to 140° F (0° to 60° C).

The cassette well is on what would be the top of the recorder when it is placed on a shelf or table. When the recorder is carried over a shoulder via its built-on strap, the cassette well is on the side for convenient loading and unloading. A small lever opens the cassette cover, while a firmer push on the lever ejects the cassette. Located near the cassette well is a pushbutton-resettable index counter.

The control panel is dominated by two large VU meters, whose scales are labelled with the standard Dolby level mark at the +3 indexes. Between the meters is a PEAK LEVEL LED that flashes when momentary peaks reach +6 dB. The meters and PEAK LEVEL indicator function in playback as well as in the record mode.

The transport mechanism is controlled by two slide-type levers. The upper lever has STOP and PLAY positions, and next to it is the REC button that must

be pressed before going to PLAY if a recording is to be made. The second lever has three positions. The left position is for rewind, center position for off, and right position for fast forward tape motion. Neither lever can be moved unless the other lever is in its stop (center) position. A PAUSE button is located just below the REC button. A red indicator comes on for the record mode.

The REC level controls for the left and right channels are concentrically ganged together. The lowest quarter of their adjustment range is marked in white as a warning that input signal levels are excessive if the controls must be set so low. Otherwise, the rest of the scales are in red for the right channel and green for the left channel. A small button below the level controls can be pressed to momentarily illuminate the VU meters or pressed and twisted to lock on the illumination. A similar button connects the right-channel meter to give an indication of battery condition.

Separate BIAS and EQ (equalization) switches are provided for setting the operating conditions to suit most tape formulations. The bias levels roughly correspond to those used with low-noise ferric-oxide and Cr02 (or the chrome equivalent) tapes. The EQ characteristics conform to the standard 120- and 70-us curves for these tapes. (The instruction booklet that comes with the recorder lists a number of suitable tapes and recommended switch settings.) The DOLBY NR switch turns on and off the Dolby B noise-reduction system, and the LIMITER switch turns on and off a peak limiter that takes effect at levels over +3 dB.

The positions on the MIC ATT switch are labelled 0, 15, and 30 (dB). With this switch properly set, it is possible to record very high sound levels without



With so many new and unproven brands on the CB bandwagon, the reasons for buying Realistic are clearer than ever. Seventeen years' experience and sales of a million sets annually have shown us what it takes to be a leader:

Intelligent, reliable engineering. Easy-to-find sales and service — to the tune of 4800 Radio Shacks in the USA alone. And low prices that are possible only because Radio Shack is a do-it-yourself company, from factory to warehouse to sales counter.

Take a look at our new high-performance mobile transceiver, the TRC-467. Advanced phase-lock loop circuitry generates all 40 channels with an electronic precision far beyond the limits of the multi-crystal sets.

Three ceramic IF filters improve the selectivity for a whopping 80 dB of adjacent-channel rejection. An automatic noise limiter cuts pulse interference, and it's switchable for maximum clarity on stronger signals.

Illuminated signal strength/RF output meter and channel selector, LED modulation indicator — conveniences that make your CB easier and more fun to use. With dynamic plug-in microphone, adjustable mobile bracket, and power cables for any vehicle with 12 VDC positive or negative ground.

Come in today and see the TRC-467. Designed, manufactured and sold only by "the" CB experts — Radio Shack. Just 119.95*.

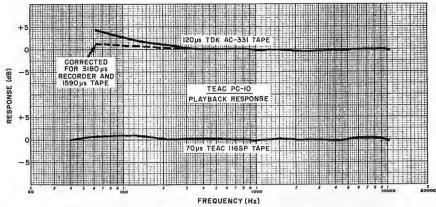


These two credit cards honored at most Radio Shacks. *Prices may vary at individual stores and dealers.

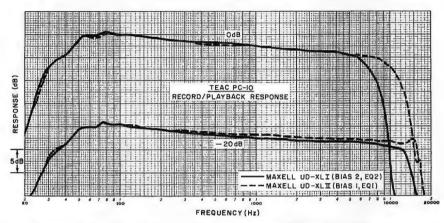
SOLD ONLY WHERE YOU SEE THIS SIGN:

Radio Shaek

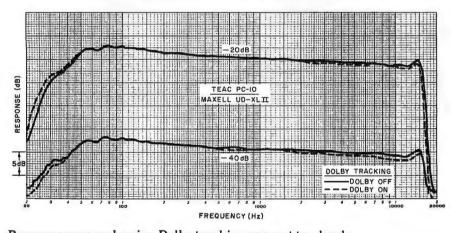
A TANDY COMPANY • FORT WORTH, TEXAS 76107 OVER 5000 LOCATIONS IN NINE COUNTRIES



Playback frequency response tests using two different types of tape.



Overall record/playback frequency responses at 0 dB and -20 dB.



Response curves showing Dolby tracking error at two levels.

overloading the microphone preamplifier stages.

Set into the right side of the recorder is a well that contains the various input and output connectors, a slide switch for selecting either the microphone or line inputs, playback output jacks, a headphone jack, and a small volume control for the built-in speaker. There is also a jack for connecting the external ac power supply to the recorder.

The published performance specifications of the recorder are similar to those for a better-quality line-operated cassette deck. The recorder can be operated continuously for approximately two hours with six fresh D cells installed.

Laboratory Measurement. We used TDK AC-331 tape with 120 μs equalization and Teac 116SP tape with 70 μs equalization during our playback frequency response tests. In both cases, the response was flat within ± 0.5 dB from 150 to 10,000 Hz, with a maximum departure from flatness of only 1 dB at the lower frequencies (which extended, respectively, to 63 and 40 Hz with the two tapes).

Several types of tapes were used to

measure the overall record/playback frequency response. The curves obtained with Maxell's ferric-oxide UD-XLI and cobalt-treated ferric-oxide UD-XL II (designed to be used with "chrome" bias and equalization) tapes were typical of the recorder's performance with other high-quality tapes. The frequency response was a nearly straight line that sloped downward with increasing frequency. The total variation was ±3 dB from 35 to 12,500 Hz using UD-XL I tape and from 35 to 15,500 Hz with UD-XL II tape. The principal difference between the two tapes was not in their frequency responses but in their high-frequency saturation characteristics. When the measurement was made at 0 dB instead of the usual -20 dB, the UD-XL II tape delivered a much better high-frequency response.

The tracking error of the Dolby circuits between the recording and playback conditions (they are supposed to be exactly balanced at all levels and frequencies) was excellent. At levels of -20 and -40 dB, there was no more than 1 dB of change in response at any frequency when using the Dolby system.

A line input of 62 mV or a microphone input of 0.22 mV was needed for a 0-dB recording level. The latter increased to 1.6 and 8 mV when the MIC ATT switch was set to its 15- and 30-dB positions. respectively. The microphone overload levels were 82, 550, and 1550 mV in the three positions of the MIC ATT switch. The playback output from a 0-dB recording level varied somewhat with the tape used. The premium ferric-oxide tapes-Maxell UD-XL II and TDK SA-gave about a 0.7-to-0.8-volt output, which roughly corresponds to the rated 0.775volt output. However, the UD-XL I tape yielded a higher output at 0.93 volt.

The playback distortion from a 0-dB recording at 1000 Hz was 0.63% with UD-XL I and 0.8% with UD-XL II tapes. The 3% THD level was reached with respective recording levels of +6.5 and +5 dB. The PEAK indicator flashed at +5 dB. The recording limiter had no effect at 0-dB or lower levels, but it made a worthwhile reduction in playback distortion when the recording levels were well off-scale on the meters. For example, at +7 dB, with UD-XL II tape, the distortion reduced from 5.3% to 2.1% with the limiter switched in. At +10 dB, the distortion was a still-tolerable 3.5%, but at 20 dB it reached an unacceptable 10%. It is clear that the presence of the limiter is not a justification for entirely ignoring recording levels.

We were pleased to note that the VU

meters were correctly named, at least with respect to their performance. Their ballistics matched the specifications for professional VU meters, with a 0.3second, 1000-Hz tone burst occurring once per second to give exactly the same meter indication as a continuous tone of the same level.

With UD-XL I tape, the S/N referred to the 3% THD level was 56.5 dB unweighted, 60.5 dB with IEC A weighting, and 56.5 dB with CCIR/ARM weighting (the type preferred by Dolby Laboratories). With the Dolby system switched in, these figures improved to 61, 68, and 66.5 dB. With UD-XL II tape, the S/N was not quite as good, yielding readings of 55 dB unweighted, 59 dB IEC A weighted, and 56 dB CCIR weighted. The Dolby system improved these figures to 56.5, 65.5, and 66 dB. The noise level through the microphone inputs was 14.5 dB greater at full gain but much less with normal settings of the recording gain. Playing a 200-nanoweber/ meter standard Dolby level tape provided meter readings within 0.5 dB of the Dolby calibration marks on the meters.

The measured wow was the 0.01% residual of our test equipment and tapes. Unweighted rms and flutter measured 0.145% in both the playback and combined record/playback tests. These figures cannot be compared to Teac's own rating, which was based on a weighted measurement. The transport operated smoothly and reliably and moved a C60 cassette from end to end in about 84 seconds. The crosstalk between stereo channels was -45 dB at 1000 Hz, measured with a TDK AC-352 test tape. All these tests were made using an ac power supply.

User Comment. The overall performance of this recorder is squarely in the class of the better component-type cassette decks used in home hi-fi systems. In fact, with respect to distortion and noise levels, almost perfect playback equalization, and virtually ideal Dolby tracking, this recorder was superior to all but a handful of the component cassette decks we have tested.

Used in a fixed home hi-fi system, the recorder's sound quality and handling convenience left little to be desired. Our only criticism of its operation concerns the eject lever. With the recorder slung over a shoulder, it is very easy to brush against the lever and inadvertently open the cassette door. Otherwise, this fine little recorder offers the best of portable and fixed operation, albeit at a price.

CIRCLE NO. 102 ON FREE INFORMATION CARD



FITS WITH ANY DECOR - YOU CAN CHOOSE ANY TYPE WOOD OR FORMICA THAT MATCHES YOUR FURNITURE

- THAT MAICHES YOUR FURNITUF
 FACTS

 1. The special LIFESCREEN® lens and front
 surface mirror supplied by Extron are the
 same type used by major big screen television manufacturers (Sony, Muntz, etc.).
 THESE PROFESSIONAL CDMPONENTS
 SHOULD NOT BE CDNFUSED WITHTHE
 CHEAP PLASTIC MAGNIFYING IMITATIONS NOW FLOODING THE MARKET BECAUSE OF THE POPULARITY
 OF BIG SCREEN TELEVISION.
- 2. Kodak Ektalite screen (recommended because it is 16 TIMES BRIGHTER than a flat matte surface and 6 TIMES BRIGHTER than not flat baded movie screens) is the same used by major big screen television manufacturers. The Ektalite screen is made of a special treated sheeting laminated to a spherically curved "shell" frame. The Ektalite screen dramatically out-performs all other types of screens by reflecting all its incident light back to the viewer instead of absorbing it. Its parabolic shape rejects extraneous light, thereby concentrating a highly efficient and directionally selective television image that is exceptionally sharp and colorful.
- Can be used with or without remote con television because the control panel is fa toward you like any conventional televis
- This system will reproduce whatever signals it receives. We therefore do not recommend it in poor reception areas. The distortion would be enlarged.

Extron LIFESCREEN* Projection System 8831 Sunset Blvd. W. Hollywood, Calif 90069

CIRCLE N

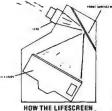
BUILD THE LIFESCREEN BIG SCREEN COLOR TELEVISION

THE CREATION OF BIG SCREEN TELEVISION A NEW DIMENSION IN TELEVISION VIEWING

- Sporting Events Are An Experience As Exciting As Being There!
- * Movies Are Seen The Way They Were Meant To
- Pong And Other Video Games Are More Exciting Than Ever!
- * Can Be Used With Video Tape Playback Equip-



The LIFESCREEN® TV was designed for the Do-It-Yourself enthusiast who wishes to have the enjoyment and excitement of a professional Big Screen TV but refuses to pay the \$1500 to \$4000 and higher prices that most major manufacturers charge for this luxury.



PROJECTION SYSTEM WORKS

I he Kodak Ektaite Screen can be purchased from a local Kodak retailer for about \$100.

The Sharp 13" Model 13A21 Color TV can be purchased from a local Sharp retailer for about \$300.

Extron can supply you with the screen or the television for the prices quoted above.

HOW TO ORDER COMPONENTS

mirror can be ordered from Extron.

The Kodak Ektalite Screen can be purchased from

If you now own a portable color TV that has a bright, color pure picture, IT MAY BE ACCEPTABLE with minor alterations, DETAILS WITH PLANS.

START BY ORDERING YOUR PLANS TODAY!

Don't he discouraged because this is a kit! This system when built according to ns is every bit as good as the projection TV's on the market today.

Extron LIFESCREEN* Projection Please Rush Me one complete set of LIFESCREEN* Please 95.00 Please also send me the items checked below:	System 8831 Sunset Blvd. W. Hollywood, Calif 90069 Calif. residents add 6% Sales Tax		
☐ LIFESCREEN * Lens @ \$150.00 ☐ LIFESCREEN * Front Surface Mirror @ \$20.00 All prices F. O. B. Factory Name.	TOTAL \$		
Address City State Zip 0. 25 ON FREE INFORMATION CARD	Card Number Expiration Date		



Auto Cigar Lighter Transmitter

It looks like the car's cigar lighter, since it's in the lighter slot. But the "Merc," developed by Mallard Manufacturing, Sterling, IL, is a one-ounce transmitter that, when pushed in just like a cigarette lighter, sends a coded signal that opens a garage door. The Merc (Mallard Electronic Radio Control) is said to work with any door opener on the market, and can be easily unplugged and moved to another car. Since it stays in the lighter slot, it isn't easily misplaced or, since it looks like the lighter, stolen. The Merc transmitter and companion receiver will sell for about \$65 together.

Hearing-aid TV Captions

The Federal Communications Commission has given approval to an electronic system for producing captions on TV programs for hearing-impaired viewers whose TV receivers are equipped with the proper decoding accessory. While this gives the nod to manufacturers who wish to make the accessories, it does not require stations to supply the captions. PBS (Public Broadcasting Service) has been experimenting with the system for two years, but opposition has come from the commercial networks who want more time for testing. According to estimates presented to the FCC, the equipment to produce the captions will cost each station \$30,000 to \$50,000 and encoding the programs is expected to add another \$1000 to \$3400/hr to production costs.

"Citizens Band" Movie

"Citizens Band," a feature movie about the phenomenon of CB radio and its effect on the lives of some of the people who use it, is being filmed on locations in Marysville and Yuba City in northern California. The Fields Company production for Paramount Pictures release is to be a contemporary comedy-drama about the personal adventures of an interrelated group of characters in Everytown, U.S.A. The movie depicts various uses of CB radio, including heroic rescue operations in highway and air emergencies. All the principal performers who use CB radios in the picture were given CB equipment and operating instructions long before the start of production so that they would become accomplished CB'ers and play their roles authentically.

The "Leap Second" Year

To keep official time in step with the spinning earth, a leap second was inserted into the world's time at the end of 1976. By recommendation of the International Time Bureau in Paris, France, the leap second began on December 31, 1976, at precisely 23:59:60 Universal Coordinated Time. It ended at 00:00:00 on January 1, 1977, making the "leap second" part of 1976, not 1977. This additional second was inserted by all standard time organizations around the world, including WWV, WWVB, and WWVH in the U.S. The 1976 leap second

was the sixth since the practice began in 1972, and is required because, in comparison with atomic clocks, the earth is slowing down enough so that the extra second is needed to keep the clocks synchronized to the spin of the earth to within one second.

WWV/WWVH Cutback

On February 1, 1977, the National Bureau of Standards discontinued broadcasts on the less-used frequencies of its two time and frequency radio stations. The affected frequencies are 20 and 25 MHz at WWV (Fort Collins, Colorado) and 20 MHz at WWVH (Kauai, Hawaii). Both stations will continue to broadcast on 2.5, 5, 10, and 15 MHz with no change in radiated power. Radio station WWVB will continue broadcasting on 60 kHz with no changes. Broadcast equipment previously used on the discontinued frequencies will be converted to serve as back-up systems for the remaining frequencies, and will be automatically turned on if the primary transmitters or antennas fail. The NBS also announced that this partial discontinuance of service will be reviewed periodically as changes occur in radio propagation conditions, sunspot activity, etc. If conditions warrant, a resumption of service on the higher frequencies will be considered.

Video Equipment Bright Spot

Frost & Sullivan, a market research organization, has detected many long-term bright spots in consumer electronics, including video tape systems, video discs, video games, and video projection systems. Despite stiff competition from the Japanese and Taiwan manufacturers for the TV receiver market, Frost & Sullivan concludes that the U.S. can dominate the field of video entertainment systems because of its early start and sophisticated circuitry. The video game market, which checked in at \$26 million in 1976, is expected to climb to more than \$130 million by 1985. There are now more than 70 companies in the field. Video tape systems will be dominated by the Japanese, with a market peaking in 1980 before giving way to video disc systems . . . if the industry agrees to standardization of software and hardware, says Frost & Sullivan.

Marine Guidelines for CB Monitors

The Coast Guard has established guidelines to assist volunteer CB-monitoring groups in relaying boating distress information. The guidelines are required to make sure a message gets through the various relay stations unchanged. The boatman can't reach the Coast Guard directly on CB because the Coast Guard doesn't monitor CB channels, a task left to REACT teams and other CB groups. The Coast Guard needs the following information: name and description of the boat, position, nature of the assistance required, number of persons aboard, radio frequencies available, name of the owner or operator and his home port and telephone number, and the name and phone number of the original contact for confirmation and callbacks.



Now you can buy Europe's No.1 CB in the U.S.A

The country that created superior steel, jet fighters, automobiles and cameras has also created the world's finest CB equipment.

handic, from Sweden, is the best selling, most popular CB in all Europe.

It is a true system. Base stations, mobiles, hand-helds and accessories interface with one another as a system should.

handic CBs have not only met but exceeded all FCC specifications at their time of introduction. Including the extraordinarily handsome new 40 channel line.

Ruggedly made for tough Swedish geography and extreme weather conditions, yet stunningly designed, handic has drawn rave reviews from CB publications in the U.S.

h a n d i c USA, Inc., 14560 N.W. 60th Ave., Miami Lakes, FL 33014

- A handic 240 in-dash 40 ch/5w Mobile CB/AM/FM Radio MPX (LED) \$259.95
- B. handic 230 under-dash 40 ch/5w Mobile CB (LED) \$1999\$ C. handic 21 2 ch/1w Hand-held CB \$59.95
- D handic 32 3 ch/2w Hand-held CB \$69.95
- E nandic 43C 4 ch/3w Hand-held CB \$89.95 F handic 65C 6 ch/5w Hand-held CB \$109.95
- G UCB Universal Cassette, Recharge/Power Holder for Hand-helds \$19.95
- H nandic S-12 Selective Call for Base & Mobile \$79.95 handic 305 3 ch/5w Mobile CB \$79.95
- handic 4005 40 ch/5w Base CB w/Sub-receive (LED) \$279 95
- K. handic 3605 40 ch/5w Base (LED) \$249.95
 L. handic 007 8ch/hi-lo band Scanner w/FM Radio \$239.95
- M handic 006-H/L 8ch/hi-lo band or UHF Scanner \$149.95
- N handic 004-U 4ch/hi-lo band or UHF Pocket Scanner \$139.95
- O BK-305 Power-pak for handic 305, 605, 006 \$34,95
- P handic 80 Base Power Mike \$4995

Please send the free handic color catalog and name of my nearest dealer.

Address

Telephone (305) 558-1522 Telex: 519139 Kennedy Building, 14560 N W 60th At Miami Lakes Florida 33014 US



Clockwise from top: CPU, 9" Video Monitor, Impact Printer, Keyboard, Cassette Storage System with Four Drives.

If you are seriously considering the purchase of a microcomputer system for personal or business use...or just beginning to feel the first twinges of interest in a fascinating hobby...the Digital Group is a company you should get acquainted with.

For many months now, we've been feverishly (and rather quietly) at work on our unique, high-quality product—a microcomputer system designed from the inside out to be the most comprehensive, easy-to-use and adaptable system you'll find anywhere. And our reputation has been getting around fast. In fact, you may have already heard a little something about us from a friend. We've found our own best salesmen are our many satisfied customers.

There's a good reason. Simply, the Digital Group has a lot to offer: state-of-the-art designs, a totally complete systems philosophy, unexcelled quality, reasonable software, affordable prices and the promise that our products will not become rapidly obsolete, even in this fast-moving, high-technology field.

The Advantages

Here are a few specific advantages of our product line:

- We offer interchangeable CPUs from different manufacturers (including the new "super chip"—the Z-80 from Zilog) which are interchangeable at the CPU card level. That way, your system won't become instantly obsolete with each new design breakthrough. The major portion of your investment in memory and I/O is protected.
- Digital Group systems are complete and fully featured, so there's no need to purchase bits and pieces from different manufacturers. We have everything you need, but almost any other equipment can be easily supported, too, thanks to the universal nature of our systems.
- Our systems are specifically designed to be easy to use. With our combination of TV, keyboard, and cassette recorder, you have a system that is quick, quiet, and inexpensive. To get going merely power on, load cassette and go!

the digital group

P.O. Box 6528 Denver, Colorado 80206 (303) 777-7133

OK, I'd like to get to know you guys better. Send me the whole package!

Name	-	
Address		
City/State/Zip		

- Design shortcuts have been avoided—all CPUs run at full maximum rated speed.
- All system components are available with our beautiful new custom cabinets. And every new product will maintain the same unmistakable Digital Group image.

The Features

Digital Group Systems – CPUs currently being delivered: Z-80 by Zilog, 8080A/9080A, 6800, 6500 by MOS Technology.

All are completely interchangeable at the CPU card level. Standard features with all systems:

- Video-based operating system
- Video/Cassette Interface Card 512 character upper & lower case video interface (1024 optional) 100 character/second digitally synthesized audio cassette interface
- CPU Card
 2K RAM, Direct Memory Access (DMA)
 Vectored Interrupts (up to 128)
 256 byte 1702A bootstrap loader
 All buffering, CPU dependencies, and housekeeping circuitry
- Input/Output Card
 Four 8-bit parallel input ports
 Four 8-bit parallel output ports
- Motherboard

Prices for standard systems including the above features start at \$475 for Z-80, \$425 for 8080 or 6800, \$375 for 6500.

More

Many options, peripherals, expansion capabilities and accessories are already available. They include rapid computer-controlled cassette drives for mass storage, printers, color graphics interfaces, memory, I/O, monitors, prom boards, multiple power supplies, prototyping cards and others. Software packages include BASICs, Assemblers, Disassemblers, Text Editors, games, ham radio applications, software training cassettes, system packages and more (even biorhythm).

Sounds neat - now what?

Now that you know a little about who we are and what we're doing, we need to know more about you. In order for us to get more information to you, please take a few seconds and fill in our mailing list coupon. We think you'll be pleased with what you get back.



INTRODUCING SPEECHLAB

THE FIRST HOBBYIST VOCAL INTERFACE FOR A COMPUTER!

Now your computer can respond to vocal commands by the simple addition of a \$250 single-board unit.

MAGINE being able to talk to your computer and have it respond by way of a hard-copy device or by activating some external appliance! Computer hobbyists can now enjoy this facility by building "Speechlab," a new, low-cost (under \$250) computer peripheral. To use it, all one does is plug the single Speechlab pc board into an Altair-bus connector (used by many microcomputer manufacturers), enter a special program, and the computer does the rest.

It's a state-of-the-art approach at a moderate cost.

One section of the program allows the user to "train" the computer to accept a vocal input (via a microphone), analyze the spoken word, and create a digitized version that is stored in memory. The second part of the program allows the user to speak to the Speechlab and have the computer generate the output selected for that particular sound.

The vocabulary size of Speechlab is a

function of the speech recognition algorithm used and the amount of memory available. For the program used in this article, it is 64 bytes per spoken word.

The unique characteristics of Speechlab open many formerly closed doors. Since Speechlab will operate with any audio input (not necessarily a recognized language), a person who's vocally handicapped can operate almost any number of appliances (TV receiver, stereo system, solenoid-operated door,

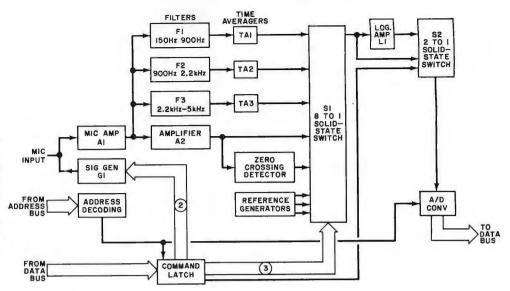


Fig. 1. The mic input is amplified, filtered and applied to S1 along with raw audio, zero-crossing detection, and three reference voltages.

Output of S1 is computer selected by switch S2 for digitizing.

etc.) using a repeatable sound such as a grunt. One can use Speechlab, too, as a vocal processor to add spoken commands to many computer games (such as the "Star Trek" game), or enter the world of artificial intelligence and advanced programming.

Circuit Operation. The basic block diagram of Speechlab is shown in Fig. 1. The audio input is amplified by A1 and applied to three 80-db/decade rolloff band-pass filters F1, F2, and F3. These filters encompass the ranges of 150 to 900 Hz, 900 Hz to 2.2 kHz, and 2.2 kHz to 5 kHz, respectively. These ranges correspond to the frequency ranges of the first three resonances of the average human vocal tract.

Each filter is passed to a time averager (*TA1*, *TA2*, and *TA3*) to generate a voltage proportional to the level of the speech waveform within each band.

The amplified audio signal from A1 is further amplified by A2 to generate an unfiltered waveform that can swing ± 2 volts about a rest level of 2 volts. This signal is also applied to a zero-crossing detector that generates a voltage proportional to the number of times the speech waveform crosses the 2-volt rest level in a given period of time, thus generating a measure of the dominant frequency in the speech signal.

These five voltages—TA1, TA2, TA3, A2, and ZCD—are fed to solid-state switch S1 along with three reference voltages used for calibration and self test. A computer output command selects one of these five voltages to be passed through S1.

The selected output from *S1* is passed to a second solid-state switch (*S2*), and to a logarithmic amplifier (*L1*) that emphasizes the low-level signal be-

fore being passed to S2. Switch S2 can select either the direct output from S1, or the output from L1, and pass this selected signal to a 6-bit A/D converter where the voltage is converted to a digital value. The output of the A/D converter is fed to the computer data bus.

All operations of the Speechlab are controlled through a single I/O port (address AFhex). As shown in Fig. 2, six bits are used: bit-5 disables the 8-to-1 multiplexer (S1), and is used when switching between bands; bit-4 controls signal generator G1 which is used either to drive the microphone so that it acts like a miniature loudspeaker for prompting during voice input, or to drive the filters and zero-crossing detector during calibration and test; bit-3 selects either linear or logarithmic scaling of the voltage applied to the A/D converter; while bit-2, bit-1, and bit-0 select one of the eight signals from S1 for A/D conversion.

The input data word contains the 6-bit A/D output in bits 0 through 5, bit-6 is unused and is always 0, while bit-7 is the A/D converter status with a 1 corresponding to busy, and 0 corresponding to finished.

Speechlab is physically configured to occupy one slot in the Altair bus, and the complete schematic is shown in Fig. 3 through Fig. 7.

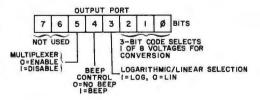
Construction. The two foil patterns (Speechlab uses one double-sided pc board) are shown half-size in Fig. 8. (Blow up to full size on *film* only.) Component layout is shown in Fig. 9.

All the components are mounted on one side of the board, with all the soldering done on the noncomponent side. Sockets are recommended for all IC's since most of them are MOS-types that may be damaged by improper handling.

Integrated circuits *IC1*, *IC4*, *IC7*, *IC8*, *IC9*, *IC15*, and *IC16* should be selected so they are capable of delivering a 4-volt output when using a 5-volt supply. Dual flip-flop *IC14* can be from any manufacturer but Fairchild, as their truth table is somewhat different from the conventional table.

Start construction by installing the voltage regulator (*IC6*), all the discrete components, and the IC sockets—do not install the IC's at this time. Check the board for correct parts installation, and to make sure that there are no solder bridges between adjacent foil traces. Mount the board in an Altair bus connector, and check for the presence of 5 volts at the output of the voltage regulator and at the appropriate socket pins. Remove the board from the computer.

Install IC2 through IC5, IC10 through IC14, and IC17 through IC22. Install the board back in the Altair bus connector, and turn on the computer. Load the test



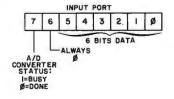
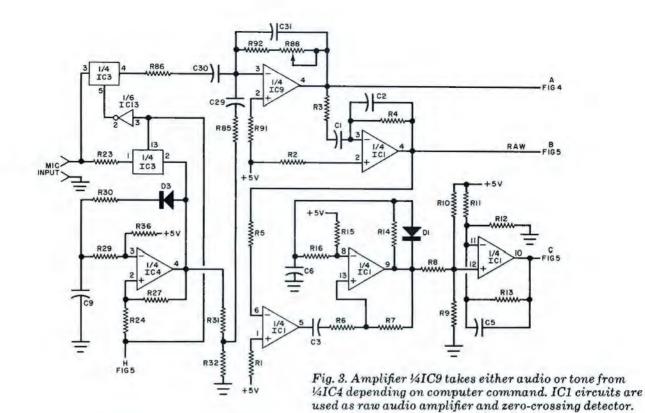


Fig. 2. Input and output port bit configuration.



PARTS LIST

Unless otherwise noted, the following capacitors are 10% Mylar types, and all picofarad sizes are CM05 types C1, C16, C21, C43, C47, C49, C52, C57-0.0047 µF C2, C31-100 pF C3, C17, C20-270 pF C4, C7, C8, C10, C12, C19, C27, C32, C33, C34, C35, C36, C37, C44, C55, C61, C62-0.1 µF, 25-V disc C5, C14, C18, C24, C54, C60-0.01 µF C6, C42, C45, C53, C56-240 pF C9, C40, C48-0.022 µF C11, C29-47 pF C13-15 µF, 25 V tantalum C15, C22, C51, C59-0.0015 µF C23-0.0022 µF C25, C26, C28, C38-1 µF C30, C39, C46-0.047 µF C41-0.1 µF C50, C58-0.001 µF D1, D3 through D6-1N4148 or 1N914 diode D2-1N746 diode IC1, IC4, IC7, IC8, IC9, IC15, IC16-LM3900 quad amp IC2-4051 8-to-1 analog multiplex IC3-4016 quad analog switch IC5-LM311 comparator IC6-78M05 5-volt regulator IC10-4024 7-stage binary counter IC11, IC18-74C174 D flip-flop IC12-4050 hex buffer IC13, IC22-4049 hex buffer inverter IC14-4013 (see text) dual-D flip-flop IC17-74LS30 8-input NAND gate

IC19-8097 three-state hex buffer

IC21-4001 NOR gate

IC20-8093 three-state quad buffer

(part of stereo set Mura DX-242)

MIC-Mura DX-121 dynamic microphone

L1-22-µH choke Unless otherwise noted, the following resistors are 1/4-W. 5% R1-619,000 ohms, 1% R2-1 megohm, 1% R3-6810 ohms, 1% -332,000 ohms, 1% R5-200,000 ohms, 1% R6,R20,R21-30,000 ohms R7, R100-3 megohms R8, R9, R10, R12, R14, R16, R104-1 megohm R11-910,000 ohms R13-2.7 megohms R15, R48-10 megohms R17,R18-20,000 ohms R19, R22, R106-10,000 ohms R23-1000 ohms R24, R27-1.2 megohms R25, R34, R39-470,000 ohms R26, R38—750,000 ohms R28, R31—100,000 ohms R29-110,000 ohms R30-39,000 ohms R32-47,000 ohms R33, R41-68, 100 ohms, 1% R35, R96, R102-75,000 ohms R36-3.9 megohms R37, R46-357,000 ohms, 1% R40, R50, R52, R54, R56, R58, R60 R61-10,000 ohms, 1% R42-12,100 ohms, 1% R43, R49-4750 ohms, 1% R44 4320 ohms, 1% R45, R47-681,000 ohms, 1% R51, R53, R55, R57, R59-4990 ohms, 1% R62-274,000 ohms, 1% R63-7500 ohms R64, R66, R72, R75-160,000 ohms R65, R71-12,000 ohms

R67, R70-300,000 ohms R68-931,000 ohms, 1% R69-2 megohms R73-620,000 ohms R74, R76, R90, R92-62,000 ohms R77-15,000 ohms R78, R83, R84-147,000 ohms, 1% R79, R80, R87-51,100 ohms, 1% R81,R82,R89-174,000 ohms, 1% R85-330,000 ohms R86-680 ohms R88-100,000-ohm pc trimmer potentiometer R91-270,000 ohms R93-249,000 ohms, 1% R94-4300 ohms R95, R97, R103, R105-360,000 ohms R98, R101-820,000 ohms R99-845,000 ohms, 1% R107-158,000 ohms, 1% R108-4700 ohms R109, R111, R117, R119-82,000 ohms R110, R116-5100 ohms R112, R115-180,000 ohms R113-549,000 ohms, 1% R114-1.6 megohms R118-510,000 ohms R120-6800 ohms R121-2000 ohms Misc.—Sockets (one 8-pin, thirteen 14-pin, seven 16-pin), regulator mounting hardware, tie-wrap etc. Note 1: The following is available from Heuristics Inc., 900 N. San Antonio Rd. (Suite C-1), Los Altos CA 94022 (Tele: 415-948-2542): complete kit of all parts including pc board, sockets, microphone, hardware manual, and 200-page lab manual, SpeechBasic, and assembly language programs at \$249. (California residents

please add 61/2% sales tax.)

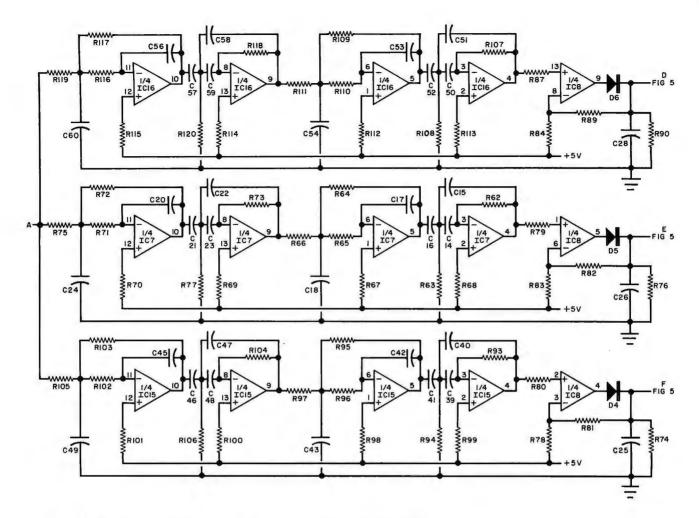


Fig. 4. Three bandpass filters and their associated time averagers. They encompass three ranges corresponding to frequency ranges of the first three resonances of an average human vocal tract.

program of Table I at 100 (hex). NOTE: all program data in this article is in hex.

You must jump to your monitor routine at address 0164-0165. Load address 195 with 05 and run the program. This will input the fixed reference voltage levels to the A/D converter and check the signal paths from switch S1 to the computer data bus.

After running this program, examine locations 200 through 20F, 300 through 30F, and 400 through 40F. Location 200 through 20F should contain 12 ± 4 , 300 through 30F should contain 24 ± 4 , and 400 through 40F should contain 36 ± 4 .

Insert the remaining IC's in their sockets, load location 195 with 10, and run the test program (Table I). This test uses the signal generator (G1) to create an input for the filters, amplifiers, and zerocrossing detector, and thereby checks the remaining signal paths on the board and calibrates, the microphone preamplifier. After running the program, examine locations 200 to 20F to see if it contains 16 to 18. If not, adjust potentiometer 1888 and rerun the program until these outputs occur.

Calibration and Test Program.

The test program (Table I) is a generalpurpose calibration, test, and diagnostic program for the Speechlab. It loads at location 100 and requires memory from 100 to 600 for program and data areas. Locations 163-165 should be loaded with a jump to your monitor address so that the program will return control to your monitor after execution. If you do not have a monitor, place a halt at this location.

The program collects four 256-byte buffers of data from four of the eight pos-

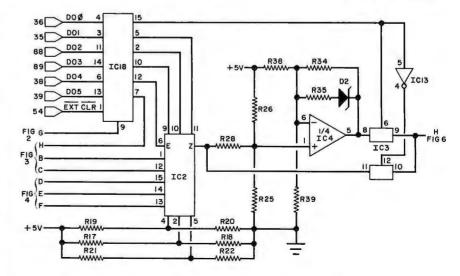
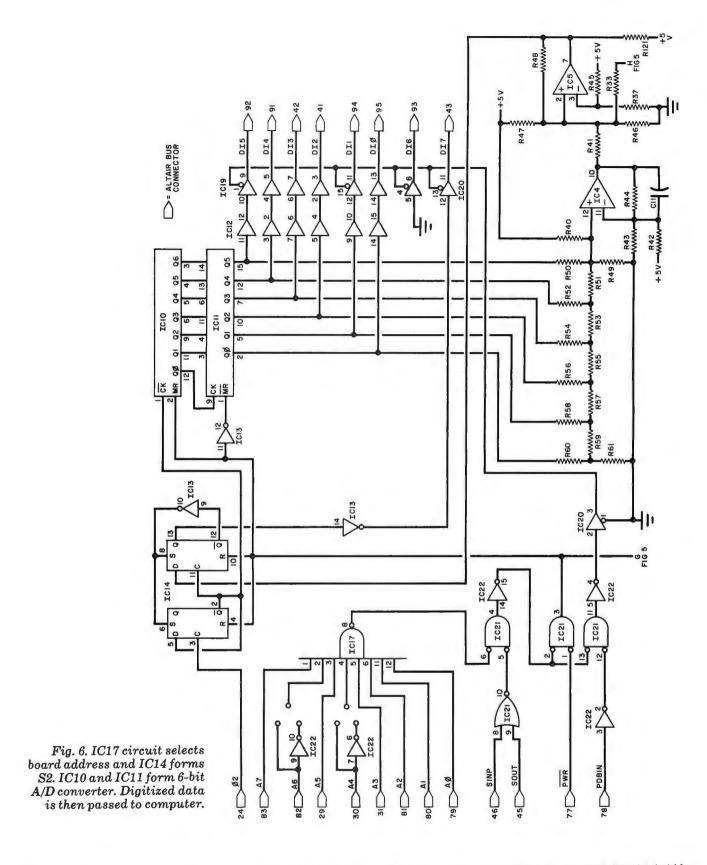


Fig. 5. Command latch (IC18) can activate tone generator and switch S1 (IC2). Op amp (4/IC4) is logarithmic amplifier.



sible inputs to the A/D converter. The first of the four bands is specified by the Test Command word, which also specifies beeper on/off and linear or logarithmic scaling. The next three bands are 1, 2, and 3 greater than specified by the Test Command word. Each band is sampled every five milliseconds until 256 samples have been collected from

each of the four bands. Data from the first band is stored in 200 to 2FF, the second band from 300 to 3FF, the third from 400 to 4FF, and the fourth from 500 to 5FF.

For example, if the Test Command word is set to 00, after the test program is run, the four data areas will contain numbers representing the outputs of band-0 (low frequency), band-1 (mid frequency), band-2 (high frequency), and band-3 (zero-crossing detector). Anything that was spoken into the microphone while the program was running, is filtered, converted into a binary number, and stored in the data areas.

If the Test Command word is set to 05, the first three data areas will contain

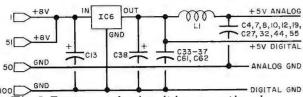


Fig. 7. Power supply circuit is conventional.

Note bypass capacitors that are actually mounted between IC power supply pins and ground.

constant numbers corresponding to the three reference voltage levels to the A/D converter on band 5, 6, and 7. This is useful for checking the A/D converter operation and isolating problem areas to one side or the other of the 8-to-1 analog switch S1

If the Test Command word is set to 10, signal generator *G1* is enabled which begins to "beep" the microphone and connects the signal-generator output into the microphone preamplifier *A1*. The four data areas contain data from bands 0, 1, 2, and 3 as when the Test Command word was 00, but the input signal comes from the signal generator rather than from the microphone. This allows calibration of the microphone preamplifier and isolates problems in one of the filter-averager chains.

Adding bit-3 to the command word will cause logarithmic rather than linear data scaling and will isolate problems to the log amplifier or either of the two analog switches comprising S2, the 2-to-1 analog switch.

Various combinations of bits in the Test Command word will allow quick calibration and fault isolation, and also provide a quick way to look at raw data from any input through the microphone.

Software. A simple technique for speech recognition of the digits zero through nine with a recognition rate of 90% or better, is shown in the flowchart of Fig. 10. An 8080 program for this algorithm is shown in Table II. The program starts at memory location 0100 and requires less than 4K bytes of storage including table space.

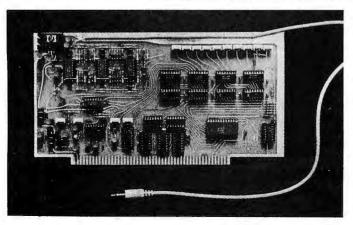
There are two modes of operation—training and performance. During training, speech examples of the digits are read into the microphone and the parameters of the speech input are extracted and placed in the tables. In the performance mode, an unknown utterance is presented and recognized.

To use the program, enter it into the computer starting at location 0100, and then run the program. The Teletype will respond with "T" (train) or "P" (perform). Type a "T" and the Teletype will respond with "NUMBER?" which can be between 0 and F. Type the digit you desire, and the microphone will emit a "beep" indicating that the speech window is open. When this beep occurs, vocalize the same digit you just typed in. The microphone will beep again to indicate that the speech window is now closed. The machine will then type T or

TABLE I

0100			ORG 100H
0100	=		START EDU 100H LXI H, START+100H
0100	210002		LXI H, START+100H
0103	228D01 210003		SHLD TEMP1 LXI H,START+200H
	228F01		SHLD TEMP2
	210004		LXI H,START+300H
010F	229101		SHLD TEMP3
0112	210005		LXI H,START+400H
	229301		SHLD TEHP4
0118	3A9501	80	LDA COHAND
	CD6601 2A8D01		CALL INPUT LHLD TEHP1
0121	77		HOV MAA
0122	20		INR L
0123	228D01		SHLD TEMP1
0126	3A9501		LDA COMAND
	C601		ADI 1
	CD6601		CALL INPUT LHLD TEMP2
0131	2ABF01 77		
0131	20		HOU MAA INR L SHLD TEMP2 LDA COMAND
0133	2C 228F01 3A9501		SHLD TEMP2
0136	3A9501		LDA COMAND
0139	C602		ADI 2
013B	CD6601		CALL INPUT LHLD TEMP3
	2A9101		LHLD TEMP3
0141			MOV M.A INR L
0142	229101		SHLD TEMP3
	3A9501		LDA COMAND
0149	C603		ADI 3
014B	C603 CD6601		ADI 3 CALL INPUT
014E	2A9301		CHED TEIN T
0151	77		HOV M.A INR L
0152	229301		
0156			SHLD TEMP4
0159	CD7701		JZ STOP CALL DELAY
	C31801		JMP 00
015F	3E00	STOP	MVI A+0 OUT OAFH
0161	D3AF		OUT OAFH
0163	C3XXXX		JHP SYSTEM
0146	F620 D3AF	INPUT	ORI 20H
	E6DF		OUT OAFH
OIAC	DBAF		ANI ODFH OUT OAFH
016E	DBAF	LOOP	IN OAFH
0170	17		RAL
0171	DA6E01		JC LOOP
0174	DBAF		IN OAFH
0176 0177	CA	BELAY	RET
0178	3E05	DELAY	PUSH B HVI A,5
	FE00	DELO	CPI 0
017C	CABB01 0669	DLLO	JZ RETDEL
017F	0669		HVI B+69H
0181		DEL1	
0182	00		NOP
0183			DCR 8 JNZ DEL1
0107	70		
0188	3D C37A01		DCR A JMP DELO
018B	C1	RETDEL	POP B
01SC	C9		RET
C000	=		EQU OCOOOH
018D		TEMP1 D	5 2
018F		TEMP2 D	5 2
0191		TEMP3 D	
0175	YY	COMAND	
0100	21 00 02	22 BD 01	21 00 03 22 BF 01 21 00 04 22
0110		00 05 22	93 01 3A 95 01 CD 66 01 2A BD
0110 0120	91 01 21 01 77 20	22 BD 01	3A 95 01 C6 01 CD 66 01 2A BF
0130	01 77 2C	22 BF 01	3A 95 01 C6 02 CD 66 01 2A 91
0140	01 77 2C	22 91 01	3A 95 01 C6 03 CD 66 01 2A 93
0150	01 77 2C 00 D3 AF	22 93 01 63 53 00	CA 5F 01 CD 77 01 C3 18 01 3E F6 20 D3 AF E6 DF D3 AF DB AF
0170	17 DA 6E	01 DR AF	F6 20 D3 AF E6 DF D3 AF DB AF C9 C5 3E 05 FE 00 CA 8B 01 06
0170 0180	69 00 00	05 C2 81	C9 C5 3E 05 FE 00 CA 8B 01 06 01 3D C3 7A 01 C1 C9 9B F7 F0
7	FE 57 DC	49 E2 A6	

"HANDS ON" EXPERIENCE WITH A TALKING COMPUTER



BY LESLIE SOLOMON, Technical Editor

While testing the Speechlab, we borrowed an Al Cybernetic Systems (Box 4691, University Park, NM 88003) Model-1000 Speech Synthesizer (\$325, assembled) to see if our microcomputer could "talk" as well as "hear." The Model 1000 is designed to fit into one slot of an Altair bus and delivers its output via an audio cable that can be plugged into any audio amplifier system. The output level is 0.6 volt p-p; impedance is 1000 ohms; and frequency range is 150 to 4500 Hz.

This synthesizer is phoneme-oriented. Accordingly, you can program it to say anything, as opposed to speech synthesizers that have only several words fixed in ROM. Essentially, the Model 1000 is a hardwired analog of the human vocal tract and various portions of the circuit emulate the vocal cords, the lungs, and the variable-frequency resonant acoustic cavity of the mouth, tongue, lips and teeth.

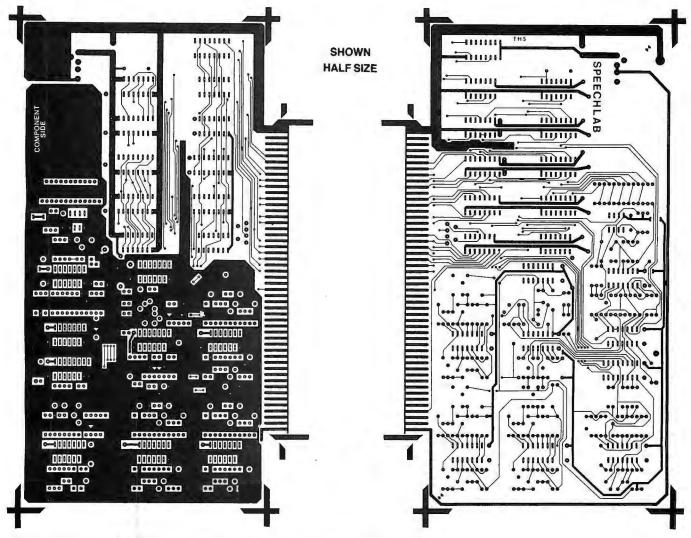


Fig. 8. Etching and drilling guides for pc board are shown half size. Guide at left is the component side. Component layout is in Fig. 9.

P again. You answer with a T, and the process is continued as long as you want. Do not exceed 16 entries with this sample program.

Once you have some vocalized digits in memory, run the program again. This time, when the Teletype asks T or P, answer with a P (for perform). Now, as you speak the digits into the microphone, the Teletype will respond by typing that digit. When used in a quiet room, with the same vocalization, this algorithm can be

All the information necessary to perform the synthesis functions are located within a ROM that is accessed by the program. Words and sentences are formed by supplying a string of ASCII characters as would be done when outputting to any port, except that these strings also use some non-alphanumeric characters (i.e., the "+" is used to form "th" as in "thaw" or "earth"). Each ASCII character represents a particular phonetic sound or phoneme. If desired, you can create a program that produces simultaneous printout and "voiceout" of the same string.

The device requires very little software to implement: less than 50 bytes of assembly language or a handful of BASIC statements. The manual accompanying the synthesizer covers speech generation in detail, how it is created, and what is involved. It also illustrates how to "mechanize" speech, with several examples shown.

After working with the synthesizer for a couple of weeks, we

found that we have a lot to learn about how humans create speech. After many hours of studying, experimenting, and redoing programs, we made the Model-1000 utter some recognizable sentences. It is not easy, our experience showed, even when one uses the wealth of instructions provided.

Working with a phoneme-oriented speech synthesizer is a little like learning to use a microprocessor. All the logic is there, but programming it properly is another story. Like working with a processor for the first time, one must crawl frustratingly before walking. Slowly, however, the ideas start to percolate. Our computer still talks with a rather heavy "robotic" accent, but we have hopes that someday it will "humanize."

To paraphrase Sam Johnson: "Sir, a computer talking is like a dog walking on its hind legs. It is not done well; but you are surprised to find it done at all." We have a long road ahead to the "HAL-9000." but the first step has been taken.

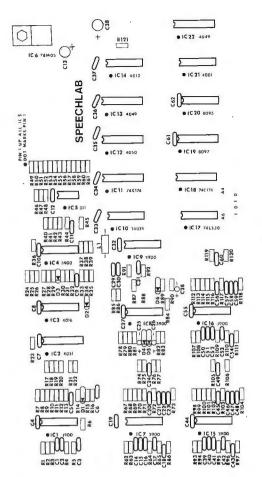


Fig. 9. Component layout for the Speechlab. See etching and drilling guide on previous page.

expected to have a recognition rate greater than 90%.

The program works as follows: the sampling subroutine is entered to obtain a sample of the amplitude every 10 milliseconds in each of the three frequency bands and to estimate the number of zero crossings during each time period. One hundred and fifty samples are collected, allowing up to 1.5 seconds of speech (between microphone "beeps"). A preset threshold is used to find the beginning and end of the word. The duration of the word can now be computed by a simple subtraction. Typically, this duration will be about 400-milliseconds for the digits. The duration time is divided by 16 to select 16 evenly spaced parameters from the three bands and zerocrossing information.

The 64 bytes obtained (16 parameters from each of the four bands) are compared with similar parameters which were collected during the training mode. A summation (running total) of the difference between the 64 parameters of the sample and the parameters of the training "templates" is computed. The totals represent a measure of the difference between the sample and each of the previously stored templates. The tem-

TABLE II

00230A3DD07F22E7EF05B10CA2560F33FDA57E04EB66609A1AAD612DD13 31 58 58 CD 58 40 99 EB 03 C119523217D2C2C28E9126E92F2EE36543E2933D76ABA91111D0832B9 5C0C6011E0CB3B3E00460E0FA9C8A670E2893F3Z020F9759E637Z617Z 033D54D31DDD181711A3A4E2D572D62301286BAE31E3B85DA77C28F08FAF7 D103D7351E293A21FBCA3AE151B43366FFF6931013F5329EF6615FDD2035F 00038A03919608AA80332214F511DEDF2527218FF03069E7E398D07440294 FC00C16C2FC03F0046320523633222DBBF11773F090B807B3E7561166DDFD50 #E5C971D1977169FDE93084558B30EFA9973F30E3ABDCDDC10784F7 979931E1A1662DD2A3178B22D92FDE35000011A400F2A4623 0333829481E271444993E53F3DA8F80271BB3A0117268 F2F338E3378833F638B378777798888 FE 52 4F 82 88 46 20 20 49

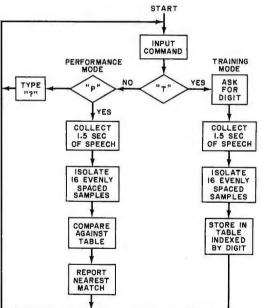


Fig. 10. Flow chart of a simple program that is used to "T" (train) and "P" (perform) a vocal operation. The program is shown in Table II.

plate with the smallest difference from the sample is then selected as the answer (output).

The above algorithm, while relatively simple, illustrates many of the basic concepts of speech recognition. A manual supplied with the Speechlab kit contains descriptions of other approaches to speech recognition, along with sample programs to demonstrate the techniques of speech recognition.

HOBBY-WRAP WIRE-WRAPPING, STRIPPING, UNWRAPPING TOOL FOR AWG 30 (-025 SQUARE POST)







STRIP

WRAP

UNWRAP



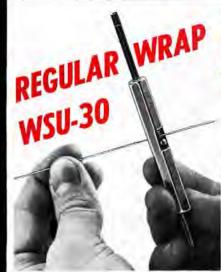
TYPES OF WRAP

A "Regular" bit wraps the bare wire around the terminal. A "Modified" bit wraps a portion of insulation around the terminal in addition to the bare wire. This greatly increases the ability to withstand vibration.



HOBBY-WRAP WIRE-WRAPPI

STRINING, UNWRAPPING TOOL FOR AWG 30 (-025 SQUARE POST)







STRIP

WRAP

UNWRAP

OK MACHINE & TOOL CORPORATION

3455 CONNER STREET, BRONX, NEW YORK, N.Y 10475 LISA. . PHONE (2)2) 994-8600

TELEX: 125091 TELEX- 232395

MOST 600 RECEIVERS SOUND AS GOOD AS THIS ONE.



UNFORTUNATELY FOR THEM, THIS ONE SELLS FOR UNDER \$300.

The average \$600 receiver sounds as good as the new Pioneer SX-650 until you start listening to prices.

If \$600 is your kind of price, an SX-650 should qualify as your kind of receiver. Not only will it give you the kind of features and sound quality you'd expect for that kind of money; it'll also leave you with roughly half your receiver budget unexpectedly unspent.

But suppose your idea of a receiver price is somewhere under \$300. The SX-650 will sound better to you than anything you thought you could afford. Because it has more power, a wider frequency range, less distortion, and far greater versatility than most other receivers in that category.

It's a fact that the SX-650 provides a continuous power output of 3.5 watts per

channel, min. RMS into 8 ohms, from 20 to 20,000 Hz, with no more than 0.3% total harmonic distortion. It also delivers each instrument and voice at its intended level, balanced within ±0.3dB of the RIAA curve.

The facts of its stereo separation, selectivity and sensitivity must really be experienced: sometimes only hearing is believing.

You'll also be impressed by what you don't hear from the SX-650. You won't hear the thousand miscellaneous acoustic devils that live in the limbo between FM stations on lesser receivers.

On your next visit to a high fidelity dealer, listen to a Pioneer SX-650 with any reasonably accurate speakers.

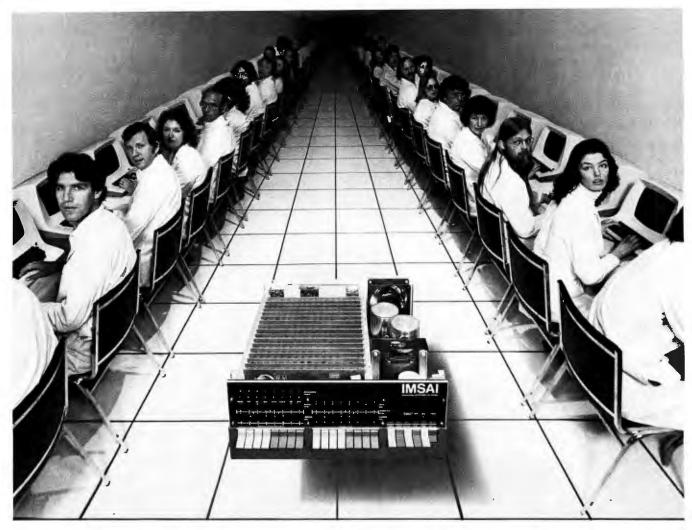
You'll find either its price or its performance amazing. Depending on which you hear first.

OPIONEER

U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074. *The value shown in this ad is for informational purposes only. Actual resale prices will be set by the individual Pioneer dealer at his option.

CIRCLE NO. 65 ON FREE INFORMATION CARD

POWER.



IMSAI Introduces the Megabyte Micro.™

The Megabyte Memory

Until today, the largest memory you could fit and address in a single microcomputer CPU was 65K.

Now, IMSAI presents an incredible memory system for micros 16 times more powerful than yesterday's best.

Imagine, a full megabyte of power from sixteen 65K RAM boards.

And, to control all this, the IMSAI Intelligent Memory Manager (IMM), the super control board.

You can write protect blocks throughout the full megabyte. Or, map in 16K blocks.

Plus, preset 16 mapping configurations with protect for high speed transfer or rapid change.

All interrupts are fully vectored, and there's an interrupt if an attempt is made to write into protected memory.

There's even a real "time of day" clock.

65K, 32K and 16K RAM Boards

Until today, the most memory you could plug into a single slot was 16K.

Now, IMSAI presents memory boards in astonishing multiples of sixteen: 65K, 32K and 16K low power, dynamic RAM Boards. They can be used in any S-100 bus computer individually or in combination to form conventional systems up to 65K bytes.

Every board is fast. With "hidden refresh" and no "wait state."

The Complete Megabyte Microcomputer System

The IMSAI Megabyte Micro™ is only part of the story. The full system can include dual floppy disks, terminals, plotters, printers and tape cassettes.

IMSAl also offers the finest high level and peripheral software available. Paper tape and Tape Cassette I/O and super Disk Operating Systems. Plus, BASIC and Disk BASIC with more high level languages coming.

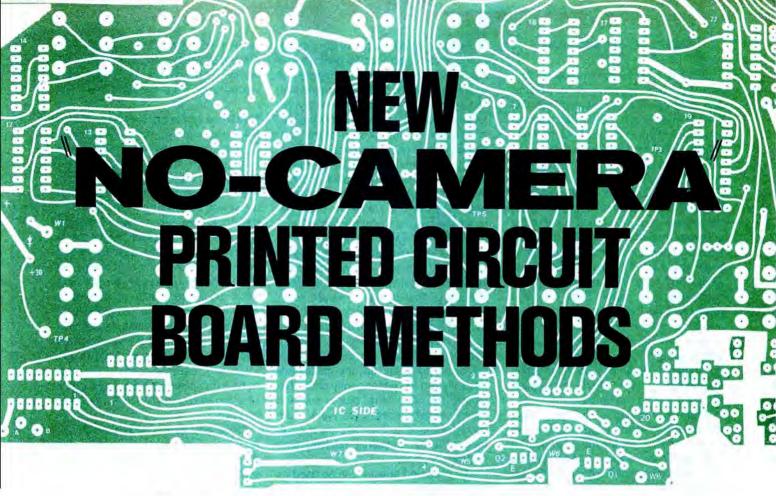
Until today, the microcomputer's potential was just something you talked about.

Now, you can put it to work. Powerfully.

CIRCLE NO. 30 ON FREE INFORMATION CARD

GENTLEMEN:	
I'm power hungry!	
Send 65K RAM Board Kit \$2599 Assembled \$3899	
Send 32K RAM Board Kit \$749 Assembled \$1099	
Send 16K RAM Board Kit \$449 Assembled \$679	
☐ Send IMM ROM Control Kit \$299 ☐ Assembled \$399	
Send IMM EROM Control Kit \$499 Assembled \$699	
Send full catalog \$1.00	
Check/MO enclosed, Amt, \$	_
Charge my: ☐ BAC ☐ M/C	
# Exp. Date:	-
Sig.	_
Send name of my nearest IMSAI dealer	
Name	
	_
Company Title	_
Address	
Adults	-
City	_
0	
State/Zin	

IMSAI Manufacturing Corporation 14860 Wicks Blvd. San Leandro, CA 94577 (415) 483-2093 TWX 910-366-7287



How to use GC Calectro and Datak kits for making pc boards directly from printed matter.

BY A. A. MANGIERI

YOU CAN now copy pc etching and drilling guides directly from the printed page without using a camera or laying out an artwork master. Two pc kits that can accomplish this dream feat for the electronics hobbyist are now on the market. One of these kits is called "Lift-It" from GC Electronics; the other is Datak's No. ER-4 kit.

The two direct-copy pc kits use different approaches to achieve essentially the same end. The Lift-It technique actually lifts the printed pattern from the page with a paint-on transparent film that has an affinity for the printing ink. The ER-4 technique uses a no-camera photographic process to duplicate or reverse a printed image or a positive or negative transparency, depending on how the copy film is exposed. Either copy method will greatly speed up the artwork portion of a construction project in which a pc board is used.

Kit Lineups. The Calectro No. J4-828

Lift-It kit from GC contains seven chemicals in bottles and cans, three trays, and pc contact film. The chemical lineup includes the paint-on Lift-It film solution around which the kit is built, board-stripping solution, contact film developer, board developer, paint-on resist lacquer, aerosol resist sensitizer, and premixed ferric-chloride etching solution. Two of the trays supplied are aluminum and are meant for the developing processes, while the third tray is plastic and is for etching only.

The only additional items needed for making printed circuit boards with the Lift-It kit are a yellow "safe" light, any of several light sources for exposing the contact film and board, and copper-clad board blanks. All chemicals in the kit come premixed and ready to use.

Datak's No. ER-4 kit uses a unique direct-photocopy process, called Pos-Neg. The kit contains four chemicals, a printing frame with yellow filter, artwork aids (layout film, drafting tape, and direct-etch dry-transfer pc patterns), photocopy film, and two copper-clad pc blanks. The two types of film developer, film fixer, and ferric-chloride etchant are supplied in powder form (to be mixed when needed), while the board developer and photoresist come ready to use.

The only additional materials needed with the ER-4 kit are a photoflood lamp, three glass or plastic trays, and bottles for the home-mix chemicals.

With both kits, you receive complete, detailed instructions on how to use them. In both cases, materials are supplied for making both positive and negative exposure masks for use with presensitized pc blanks (single-sheet original artwork can measure up to 5" by 5").

Note: The two methods are described separately on the following two pages. Methods of transferring from artwork to pc board are given on the final page of this article.

THE "LIFT-IT" METHOD

If you are new to pc techniques and have little or no experience in working with photographic techniques, the GC Lift-It kit may prove to be more convenient to use. There are no photo methods used in making the first film artwork.

Since using the Lift-It method destroys the original published etching and drilling guide, it pays to photocopy both sides of the magazine page on which the artwork appears so that none of the published material is lost. Cut the page from the magazine, trim the artwork to leave about 1/4" (6.35 mm) excess on all sides, and tape the artwork flat on a sheet of waxed paper. Paint the Lift-It emulsion over the entire surface of the artwork and allow to dry for 15 minutes. Repeat painting on the Lift-It emulsion and allowing it to dry until six thin, even coatings have been built up. After applying the final coating, allow the emulsion to dry for at least two hours.

When final drying is complete, soak the artwork in warm, soapy water for an hour or more. Remove the artwork from the soaking bath and carefully remove the softened paper from the Lift-It film by rubbing with the tip of your finger. Be careful to avoid tearing, stretching, or deforming the film. If particles of paper

prove to be stubborn, return the artwork to the soaking bath for 15 minutes to a half hour. Finally, when all particles of paper have been removed from the film, allow the latter to completely air dry, after which you can apply a coat of the Lift-It emulsion to the ink side of the film. Make this coat as thin as possible.

You can greatly reduce the time to make the first artwork if, after applying the Lift-It emulsion, you dry it under a heat lamp or in a just-warm oven. Arrange the heating to dry the film in 3 to 5 minutes. (The wet emulsion is milky: as it dries, it becomes clear.) Using heat to speed up the drying, you can put the artwork in the soaking bath after 30 to 45 minutes of final drying. To reduce soaking time, tape the artwork, paper side up, to a clean glass plate and place both in the bath. After 10 minutes or so of soaking, cautiously rub the surface of the paper to break up any glaze. Repeatedly rub the paper gently until it begins to roll off in small bits at first and then in larger pieces. If the paper stubbornly adheres to the film, do not rub harder; allow additional soaking time and then proceed.

The prepared artwork can be used as is to expose presensitized pc blanks treated with positive photoresist, such as GC's No. 22-232 spray-on positive

resist (use only GC No. 22-225 resist developer when using this positive photoresist—not the No. J4-630 board developer supplied in the Lift-It kit).

Positive to Negative. Assuming you are using negative photoresist and have a Lift-It positive, the next step is to make a negative of the Lift-It artwork. To do this, you use the contact film supplied in the kit. The procedure is simple. Working under safe-light conditions, you cut the film to size, place it glossy side up in a contact frame (such as GC's No. 22-280 frame), place over the film the Lift-It positive with ink side down, close the frame, and expose it under coolwhite fluorescent light. If you do not have a contact frame, two clean sheets of glass will do. Excellent results are obtained with a pair of 20-watt cool-white fluorescent lamps at a distance of 4" (10.2 cm). Exposure time will first have to be established by exposing segments of a thin strip of the film for 1/2, 1, 2, and 4 minutes.

Once you have established the correct exposure time and have exposed the film through the Lift-It positive, switch to safe-light conditions, remove the film from the contact frame, and place it, dull side up, on a clean sheet of glass. Flow onto the film a liberal quanti-

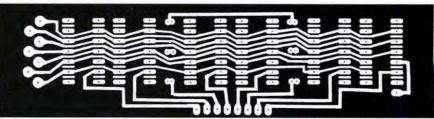
THE "POS-NEG" METHOD

The Pos-Neg method used in the Datak ER-4 kit depends on accurate timing during the exposure of the sensitized film supplied in the kit. Using the Pos-Neg copy mode, you can directly copy the pc etching and drilling guide from the printed page. This results in a film positive that can be used directly to expose positive-resist-sensitized pc blanks.

To use the direct-copy Pos-Neg method, you begin by loading the contact frame (included in the kit) with the printed etching and drilling guide with the artwork facing up, followed by a narrow test strip of the sensitized film with its brown side up, and with the yellow filter on top. The whole is firmly sandwiched together between the contact frame and its top glass.

Next, you expose the test strip in blocks for 30 to 100 seconds at 10second intervals. After developing and fixing the exposed film strip, you may find only one block satisfactory for your

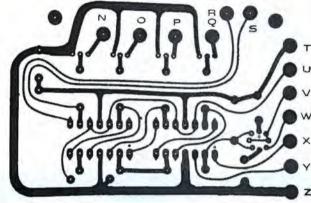




Typical ER-4 mask.



Mask made using the "Lift-It" process.



ty of contact-film developer. Soak a wad of cotton with the developer and rub gently, in a circular motion, over the entire dull surface of the exposed film. After a minute or two, the areas of the film that were not exposed to the exposing light will begin to dissolve and come away from the film. Continue rubbing until all soft areas of emulsion have been removed. Be as gentle as possible with your rubbing because the emulsion left behind at this point will be soft. When all unwanted emulsion has been removed, rinse the film under gently running warm water and allow to dry completely.

What you should now have is a high-contrast film negative with opaque orange areas surrounding water-clear conductor areas. The details should be as sharp as they are in the Lift-It positive. Carefully examine the film negative for discontinuities and other flaws. You can repair discontinuities by cutting away the appropriate portions of the film with a razor blade or sharp X-acto knife. Pits and other flaws in the emulsion can be repaired with the paint-on resist lacquer in the kit.

Although exposure time is not critical, gross underexposure will result in complete removal of the emulsion. Conversely, gross overexposure might preclude any development at all.

needs. The "good" block will have almost opaque blacks surrounded by a slight brownish haze in the "clear" areas. It is usually necessary at this point to run off another test strip, this time in 3-second steps that span the exposure time of the "good" test block, to determine the exact required exposure time within 3 seconds.

Since the Pos-Neg technique involves both direct and indirect lighting effects, it is quite critical. An accurate enlarger timer to control the on-time of the photoflood light will prove helpful. If you do not have an enlarger timer, you can use a clock with a sweep second hand and manually control the lamp.

At all times, the presensitized film must be in intimate contact with the printed etching and drilling guide. Additionally, there can be no "print-through" in the artwork. If printing on the reverse side of the page from the etching and drilling guide is visible, back the artwork with matte black paper.

The simplest of the photo copying

procedures with the ER-4 kit is the duplication of a positive from positive or negative film transparency. Here, again, you must determine the proper exposure time. You load the contact frame with the grey side of the sensitized film up, transparency, and yellow filter on top, and expose in blocks for 20 to 90 seconds in 10-second intervals. After developing and fixing the exposed film, the correct exposure time will be that represented by the block with opaque black areas surrounded by water-clear areas.

Positive to Negative. Two separate exposures of the sensitized film are required to make a positive from a film negative or vice-versa. First, you must determine a "clearing" time. To do this, you load the contact frame with the film test strip with its grey side up and place the yellow filter on top. Then, you expose the strip in blocks for 20 to 90 seconds in 10-second intervals. After this, you develop the film in fresh developer at 68° F (20° C) for 2 minutes, place it in

the fixer for 5 minutes, wash it under gently running water, and allow it to dry. The test strip should go from fully opaque black to fully water clear, with one or two intermediate shades. If the first fully clear block was exposed for 60 seconds, the clearing time is 70 seconds, for example. Record the clearing time for future reference.

Now, to reverse your film transparency, you first expose the entire test strip through the yellow filter for the recorded clearing time. Then, remove the yellow filter and substitute it with the film transparency and expose again in blocks for 3 to 21 seconds at 3-second intervals. After developing, fixing, and washing the test strip, select the block that has opaque blacks with water-clear whites. You now know the exposure times for both clearing and copying.

The ER-4 Pos-Neg system sounds more complicated than it really is. Once you gain some experience with it, it will be no more difficult to use than were other "photo" methods used in the past.

FROM ARTWORK TO BOARD

With very little practice, you can easily photosensitize copper-clad pc blanks. The blanks must be flat and free of ragged edges. The best way to deal with a ragged edge is to use a fine steel file to remove copper burrs and fine emery cloth to smooth the edges. Next, thoroughly scour the copper with a steel-wool soap pad until it has a burnished finish and sheds water. Rinse thoroughly and allow to air dry, either at ambient room temperature or in a just-warm oven. Do not wipe the blank dry with a towel. The blank is now ready to be sensitized with photoresist.

Go to safe lighting conditions and place the pc blank with its copper side up on a couple of thicknesses of newspaper, thoroughly shake the can of spray resist, and spray a thin, even coating of the resist over the entire copper surface. Dry the resist for an hour at room temperature or for 15 minutes in a just-warm oven. Then inspect your work under safe lighting. If the coating of resist lacquer appears to be too thin, apply a second thin, even coat and again allow to dry. Before taking on a big job, develop a "feel" for the spray technique, using a piece of scrap pc blank.

Finishing Steps. Under safe light, place the sensitized pc blank in the contact printing frame and place the exposure mask on top. Make absolutely certain that the proper side of the mask is in contact with the blank. You can now expose the blank with any of four light sources, detailed in the instructions supplied with the kits. A fluorescent lamp with two 20-watt cool-white tubes at a distance of 4" from the top of the contact frame is suitable. You will have to determine the proper exposure time by trial and error with sensitized scrap pc blank.

Once the blank has been exposed, go to safe lighting and immerse it in the appropriate pc board developing solution and agitate. Remove the blank from the solution promptly when the circuit pattern appears, usually in about a minute or less. At this point, the resist is no longer sensitive to light, and you can switch back to normal lighting. Flush the developed blank under gently running water and allow to air dry at room temperature for an hour or in a just-warm oven for about 20 minutes. At no time before the board is dry should you touch the resist pattern. The pattern will still be soft and easily damaged.

After drying is complete, carefully inspect the pattern for faults and use

paint-on resist lacquer or dry-transfer patterns to touch up any breaks. Then etch the blank in pc etching solution. You can speed up the etching time by preheating the etching solution by setting the bottle of solution in hot water until it becomes too hot to handle. Do not pour the etchant into a pot and heat it directly on a stove. Pour the etchant into a glass or plastic tray large enough to accommodate the pc blank. Place the blank, copper side down, in the hot etchant and agitate the bath by gently rocking it back and forth. Periodically check the progress of the etching after 20 minutes. When all unwanted areas of copper have been etched away, remove the pc board from the etchant and thoroughly rinse it under running water. Then remove the resist on the copper with pc board stripping solution.

The final step in making a professional-quality pc board at home is to trim the board to size and drill all component-lead and mounting holes. From initial artwork to ready-to-go etched and drilled board, the job should take between five and eight hours, depending on the size and complexity of the board. The boards you make with either of the two kits described here will be indistinguishable from boards made by a professional. ♦



WIRE WRAPPING TOOL

For AWG 30, .025" (0,63mm) sq. post, "MODIFIED" wrap, positive indexing, anti-overwrapping device



OK MACHINE & TOOL CORPORATION

3455 Conner St., Bronx, N Y 10475 / (212) 994-6600 / Telex 125091



If Youre Still

This Library is the most ware both to easily per programs of the intention to easily per programs of the intention of the inte

This LIBRARY is a complete do it yourself kit. Knowledge of programming not required. EASY to read and USE. Written in compatible BASIC immediately executable in ANY computer with at least 4K, NO other peripherals needed.

Line Up

422,95 **VOLUME ONE** Pert Tree Roulette Rate Return 1 Sky Diver Part 1 Tank B1410 BOOKKEEPING Schedule 1 Teach Me Part 2 PICTURES Building Compound A. Newman GAMES Cyclic Animals Four Linus Decision 1 Astronaut Ms. Santa Decision 2 Bagel Nixon Depreciation Bio Cycle Noel Noel Efficient Cannons Checkers Nude Flow Peace Installment Craps Policeman Interest Investments Dogfight Santa's Sleigh Golf Mortgage Snoopy

Virgin

VOLUME TWO Rand 2 Differences Solve **Dual Plot** Sphere Trian Exp-Distri Part 3 Least Squares MATH & ENGINEERING Track Paired Triangle Plot Beam **Plotpts** Conv. Vector Polynomial Fit Filter Regression Part 4 Integration 1 Stat 2 Integration 2 PLOTTING & STAT T-Distribution Intensity Binomial Unpaired Lola Chi-Sa. Variance 1 Macro Coeff Variance 2 Max. Min. Confidence 1 Navaid Confidence 2 Optical APPENDIX A Correlations Planet BASIC STATEMENT DEF Rand 1

This Library is the most comprehensive work of its kind to date. There are other software books on the market but they are dedicated to computergames. The intention of this work is to allow the average individual the capability to easily perform useful and productive tasks with a computer. All of the programs contained within this Library have been thoroughly tested and executed on several systems. Included with each program is a description of the program, a list of potential users, instructions for execution and possible limitations that may arise when running it on various systems. Listed in the limitation section is the amount of memory that is required to store and execute the program.

Each program's source code is listed in full detail. These source code listings are not reduced in size but are shown full size for increased readability. Almost every program is self instructing and prompts the user with all required running data. Immediately following the source code listing for most of the programs is a sample executed run of the program.

This Library is destined to become one of the reference, bibles for the small computer field, due to its versatility and uniqueness and the ease of operation of the programs it contains. These volumes are deductible as a business expense when purchased by a company. Send your remittance for prompt delivery, while supplies last. Volume discounts are available to qualified dealers.

The entire Library is 1000 pages long, chock full of program source code, instructions, conversions, memory requirements, examples and much more. ALL are written in compatible BASIC executable in 4K MITS, SPHERE, IMS, SWTPC, PDP, etc. BASIC compilers available for 8080 & 6800 under \$10 elsewhere.



VOLUME I & II — \$24.95 each VOLUME III — \$39.95 each VOLUME IV — \$9.95 each

Add \$1.50 per volume for postage and handling.

VOLUME THREE

Part 5

Optimize

Order

ADVANCED BUSINESS

Billing Inventory Payroll Risk Schedule 2 Shipping Stocks Switch BASIC SOFTWARE LIBRARY YOLUME III

SCIENTIFIC RESEARCH

1712-P FARMINGTON COURT CROFTON MD 21114

Phone Orders call (800) 638-9194

Information and Maryland Residents Call (301)-721-1148

BANKAMERICARD



...you'll want it for its features ...but it's the price that will sell you!

- High intensity LED display is easily read from at least 6 feet in the brightest room.
- Measures AC and DC voltage, AC and DC current and resistance.
- 0.5% DC accuracy.
- 100% overrange (1000 scale reads to 1999).
- Automatic polarity.
- Automatic decimal point.
- Flashing overrange indication on display.
- Four voltage ranges to 1000V
- Four current ranges to 1000mA.
- Six resistance ranges to 10 meg.
- In-circuit resistance measurements at voltage levels below conduction threshold of semiconductors.
- Overload protection on all ranges.

Complete new circuitry makes the Model 283 the most dependable and versatile 3½ digit multimeter you can buy. The extra-bright display allows you to use it where other units would cause reading problems. The selectable "low ohms" function permits accurate measurement of semiconductor shunted resistors.

An optional, internal battery pack (BP-83, \$50.00) provides 8 hours of continuous use on one overnight charging and charges when the Model 283 is in use on 115/230VAC.

Thoughtful, convenience features like a side carrying handle, tilt stand and detachable line cord add to its usefulness.

Your B&K-PRECISION distributor has them in stock and will be glad to demonstrate its features to you. Call him, or write for additional information.



6460 West Cortland Avenue Chicago, Illinois 60635 • 312/889-9087 In Canada: Atlas Electronics, Ontario



Build a Legal In-Flight AIRLINE RECEIVER

Hear pilot-to-control conversations while in-flight with low-cost Varactor-tuned crystal set.

BY CASS R. LEWART

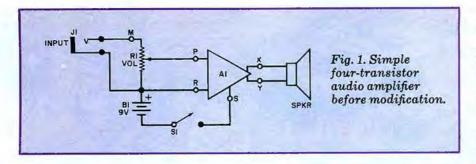
UNTIL NOW, "armchair pilots" wishing to listen to airplane-to-tower communications have had to confine their activities to ground-based monitoring. But the project described here—essentially a vhf crystal set with a small audio amplifier—will allow reception of such conversations when the user is on board an airliner. It will do so without creating any hazard to the plane's navigation system. The receiver is easily built, using readily available, inexpensive parts.

About the Circuit. Unlike superheterodyne receivers, whose local oscillators generate signals which can interfere with reception in the 108-to-118-MHz radio-navigation band, this project can be used with complete safety. The heart of the project is a 4-transistor audio amplifier with a built-in speaker, shown schematically in Fig. 1. Power switch S1 is ganged with R1, the volume control. The amplifier draws current from a single 9-volt transistor battery, B1.

A few modifications transform this amplifier module into an airline receiver, shown schematically in Fig. 2. The receiver comprises a tuned r-f circuit (L1, C1 and D1), a demodulator (D2) and the modular audio amplifier. The tuned cir-

cuit is unusual in one respect—it uses a voltage variable capacitor or Varactor as the variable capacitance. This diode, when reverse biased over a range of 0 to 9 volts, behaves like a variable capacitor of 5 to 15 pF. Because C1 is in series with D1, the effect of the fixed capacitor is neglible. The combination of L1, a small hand-wound coil, and D1 resonate to provide coverage from 118 through 135 MHz. (Construction details for L1 are given on the next page.)

A short piece of insulated, stranded hookup wire serves as an antenna. The wire is terminated with a pin or banana plug (P1), and is connected to the rest of



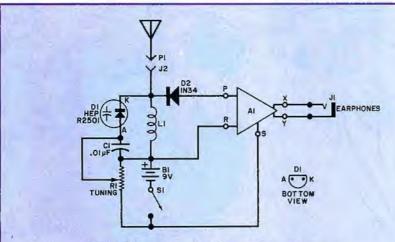


Fig. 2. Schematic of the amplifier with minor additional circuits needed to make airline receiver.

PARTS LIST

A1—Modular Amplifier (Radio Shack 277-1008 or equivalent)

B1-9-volt transistor battery

C1-0.01-µF, 50-V disc ceramic capacitor

D1—5-15-pF voltage-variable capacitance diode (Motorola HEP R2501—do not substitute)

D2-1N34 germanium diode

J1-Miniature phone jack (part of A1)

J2-Pin or banana jack

L1—Five turns of No. 24 enamelled copper wire on a 36-inch form, approx. 10 turns per inch

P1-Pin or banana plug

R1-Volume/tuning control (part of A1)

S1-Spst switch (ganged with R1, part of A1)

Misc.— Dynamic earphone (8 ohms), hookup wire, solder, etc.

Fig. 3. Unmodified (A) and modified (B) wiring to R1 to convert it from volume to tuning control.

X=BREAK CONNECTION

TO BATTERY

TO BATTERY

TO D2

ANODE

TO CI AND DI ANODE

the circuit via J2, a pin or banana jack. Signals are thus applied to the tuned circuit, which is resonated by means of R1. This potentiometer, which served as the volume control in the unmodified amplifier, functions as a voltage divider to apply variable reverse bias across D1.

After the vhf signal has been boosted by the parallel LC circuit, it is demodulated by germanium diode *D2* and applied to the audio amplifier. The output of the amplifier drives a dynamic earphone plugged into jack *J1* (the former input to the amplifier).

Construction of the receiver is greatly simplified by modifying a ready-built audio module and adding a few additional components. In the author's prototype, a Radio Shack 277-1008 amplifier was used. However, other units can be used equally well. The additional components fit in place of the module's speaker.

Start by removing the three small Phillips screws which secure the amplifier pc board to the plastic enclosure. Then remove jack J1 and unsolder the leads running to it. Raise the pc board and unsolder the leads connected to the speaker. Remove the speaker by softening the glue holding it to the plastic enclosure. Use acetone or nail-polish remover and pry the speaker away with a sharp knife. Then attach what were the speaker leads (points X and Y) to J1. Polarity is not important.

Refer to Fig. 3A and 3B for the following steps. Open the pc foil running from the volume control (R1) to the amplifier input (point P) and to the input jack (point M) by scraping it off with a sharp blade. Connect the terminal previously running to point M to one side of switch S1 (point S), which is ganged with R1. Solder a wire to the wiper of R1 and connect the other end to one side of C1 and the anode of D1. Then solder a wire to the pc foil that formerly ran to the wiper of R1 (on the other side of the break in the foil), and attach the other end of the wire to the anode of D2.

Next, drill a hole about 1-9/16" (3.97 cm) from the top of the enclosure on the left side (as viewed from the rear) to accommodate J2, the antenna input jack. Mount the jack and secure the pc board to the enclosure with the three small Phillips screws. To form L1, wind five turns of No. 24 enamelled copper wire on a %-inch (9.53-mm) form, spaced about 10 turns per inch. Scrape the insulation off the ends of L1 and position the coil in the speaker cutout of the pc board. Connect D1, D2, L1, and C1 as indicated in the schematic, using J2

for mechanical support. Be sure to observe correct polarity for the diodes or you will damage them. Solder all remaining connections.

Alignment. The best way to align the receiver is to couple it to a signal generator producing an output at 125 MHz with internal 400-Hz modulation. Connect a small dynamic earphone to J1 and set the tuning control (R1, the former volume control). Compress or expand the winding of L1 for maximum audio output. If you can't get access to a signal generator with the required output, just go to your local airport. Connect a short (one foot or so) wire terminated with a suitable plug to J2, and listen to transmissions from the airport tower. Adjust L1 for best reception with R1 at center position.

Operation. The airline receiver is very simple to use. When you are taking a flight, try to get a seat near the window. Attach the antenna wire to the window with a small piece of masking tape, and plug the earphone into J1. This will allow you to monitor the pilot's conversations without causing a commotion.

You will not usually know the exact frequencies used by a particular airplane. Airport towers generally transmit and receive below 120 MHz. Other communications can be found anywhere between 120 and 135 MHz. Between takeoff and the time when a plane reaches cruising altitude, its pilot will use several frequencies in succession, communicating with the tower, departure control, and possibly to the particular airline controller. Similarly, the pilot will use several frequencies during the descent.

Each conversation will be brief, lasting only a few seconds. Accordingly, an important characteristic of this receiver is its broad selectivity as compared to that of a superheterodyne receiver. The user can therefore leave the tuning control at its center position. The pilot's transmission will still be heard—even if the tuned circuit is not resonant exactly at the operating frequency. The receiver can be quickly retuned for optimum reception if desired. Another possibility is to continuously tune the receiver back and forth, scanning the band until you can hear the pilot's voice.

When using the receiver, you may try to explain to the stewardess what you are doing in case other passengers think you are using a radio that might foul up airline communications. Your radio is similar to a tape recorder which would be permitted on board.



CIRCLE NO. 34 ON FREE INFORMATION CARD

McIntosh CATALOG and FM DIRECTORY

Get all the newest and latest information on the new McIntosh Solid State equipment in the McIntosh catalog. In addition you will receive an FM station directory that covers all of North America.



MX 113

FM/FM STEREO - AM TUNER AND PREAMPLIFIER



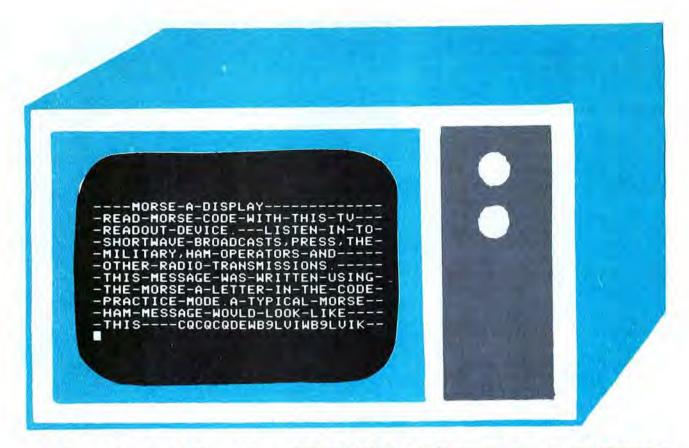
	McIntosh Laboratory, Inc.
ı	East Side Station P.O. Box 96
	Binghamton, N.Y. 13904
	Dept. PE
- 1	NAME
	NAME
- 1	ADDRESS
- 1	CITYSTATEZIP

If you are in a hurry for your catalog please send the coupon to McIntosh.

For non rush service send the Reader Service Card to the magazine.

CIRCLE NO 35 ON FREE INFORMATION CARD

L



MORSE CODE AUTOMATIC READOUT ON A TV SCREEN

How to interface the Morse-a-Letter to a "TV Typewriter."

BY GEORGE A. STEBER, WB9LVI

LTHOUGH the Morse-A-Letter (January 1977) deciphers Morse code signals very effectively, its usefulness is somewhat limited by its single-character LED readout. At higher code speeds, the characters are displayed briefly, straining the operator's ability to copy down the entire text. However, it's easy to interface the Morse-A-Letter to a "TV typewriter." This combination, called "Morse-A-Display," will allow message display in page format—a boon to CW operators and SWL's interested in copying Morse.

Designed with this application in mind, the Morse-A-Letter contains all electronics necessary for converting dits and dahs to TTL-compatible ASCII-6 code. The required interface is simple and straightforward. All features of the original project are retained.

ASCII. Before examining the interface, let's review some basics of ASCII code. This will help us understand how the Morse-A-Letter/TV typewriter team op-

erates. ASCII is a standard 8-bit information code used with most computers and data terminals. It may be used in the parallel (all bits present simultaneously on separate lines) or serial (one bit at a time on a single line) mode. Most systems do not use the eighth bit of the code and it is, therefore, assumed to be a logic one at all times. Some systems, however, use the eighth bit for parity or error testing. The remaining seven bits provide a total of 128 possible charac-

INTERCON	NECTIONS
Morse-A-Letter Connector	TV Termina Connector
A13	Bit 7*
A21	Bit 6
A20	Bit 5
A19	Bit 4
A18	Bit 3
A17	Bit 2
A16	Bit 1
A14	Strobe
A1, A9	Ground
* Optional, see text	

ters. Of these, one group of 32 is reserved for the upper case alphabet and a few punctuation marks. Another group of 32 is used for numbers, spacing and additional punctuation symbols. Rarely used punctuation marks and a lower case alphabet are assigned a third group of 32. Finally, the last 32 combinations are assigned as machine or control commands. This group does not actually get printed but is provided to handle hardware operations such as line feed (LF) or carriage return (CR). If only upper case alphanumerics are needed, only the first two groups of 32 codes are required, and only six of the eight bits of the code are used. This diminutive AS-CII code is called ASCII-6 and is essentially the code produced by the Morse-A-Letter. No control codes are produced by the Morse-A-Letter, however, so most "housekeeping" operations (line feed, carriage return, etc.) must be performed by the TV terminal. This does not present a real problem, since most TV terminals are programmed to handle

these operations automatically in the absence of specific commands.

Interfacing. Almost any TV terminal capable of receiving TTL-level, 7-bit parallel ASCII code can be used with the Morse-A-Letter, Most terminals will work well with the ASCII-6 code without any changes or additions. However, some terminals require the presence of the seventh bit (B7-not to be confused with edge connector location B7) to produce a question mark (?), due to the method used to check control characters. If the seventh bit is required by your terminal, don't despair! It can easily be obtained because B7 is merely the complement of B6 for the 41 valid ASCII characters produced by the Morse-A-Letter. This modification requires a small amount of additional wiring on the Morse-A-Letter circuit board. Fortunately, no additional parts are needed since an unused inverter (actually one half of IC5, a 7413 dual NAND Schmitt Trigger) is already "on the board."

To generate bit 7, connect a wire from B6 of the ASCII output (edge connector location A21) to pin 13 of *IC5*. Also, connect a wire from pin 8 of *IC5* to edge connector location A13. This becomes B7 of the ASCII code. Keep in mind that

many TV terminals will function adequately with just the ASCII-6 code, so this addition may be optional.

The TV terminal will normally require a "data ready" signal to tell it when an ASCII character is applied to its input connector. This signal is also sometimes referred to as a "keypressed strobe" or "new character" pulse. It is usually a positive going pulse that appears whenever the ASCII character is ready to be entered. The Morse-A-Letter provides this new character pulse in the form of a positive going pulse at edge connector location A14, which is generated every time a new Morse character is received.

A word of caution is in order. If your terminal does not utilize TTL levels at the ASCII input connector and/or requires a negative-going strobe pulse, an additional interface is needed.

As an example of an interface, the Table lists the wiring requirements for interfacing the Morse-A-Letter to the Southwest Technical Products CT-1024 Terminal, which has a TTL-compatible input and a positive strobe line. All that's required is connecting a suitable cable from the appropriate points on the Morse-A-Letter connector to the TV terminal connector. Note that no power supplies or additional electronics are

necessary. Most other TV terminals will interface in a similar manner.

Operation. There are no adjustments required for the Morse-A-Display other than the normal code speed adjustment. It will function in either the code practice or the reception mode. Once a signal is properly tuned in, the television display will read out the incoming characters directly on the television screen. Illegal Morse characters will be displayed as "@." Noisy signals may generate strings of "E"s or "T"s on the screen, but this is normal. Do not expect to view perfectly edited copy since word spaces are rarely sent in Morse code and the Morse-A-Display is not designed to decode them. This is not a serious handicap, however, and with a little practice you will be able to read complete messages from the screen. To copy high-speed Morse, it might be desirable to reduce the Morse-A-Letter's C9 from 6.8 crofarads to 2.0 microfarads in the original circuit. This reduces noise immunity slightly, but enables copy at code speeds up to 50 WPM or more.

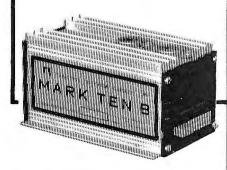
Remember it is illegal to pass information garnered from ship-to-shore, military, or press transmissions to third parties.

SCORE 2 WAYS WITH MARK TEN B AND...

You can add real zip to engine performance and eliminate the need for 3 out of 4 tune-ups with a Mark Ten B Capacitive Discharge Electronic Ignition. Over a million happy, satisfied users testify to the fact that the Mark Ten B really does:

- · Eliminate 3 out of 4 tune-ups.
- Improve gasoline mileage up to 20%.
 Give dramatic increases in
- Give dramatic increases in acceleration and general performance.
- Extend spark plug life 3 to 10 times.
- · Give instant all weather starts.

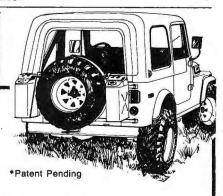
Put spark under the hood and score with *real* performance!



DELTA'S MOUNTAIN MAN SADDLE BAG CAN AND ACCESSORY CARRIER*

The only carrier with truly innovative engineering, Delta's Mountain Man Carrier installs without drilling a single hole. A completely unique concept, it forms the basic unit of the first modular system ever devised to carry a variety of accessories. Look at these great features:

 Versatility: use alone with one or two jerry cans, or use with other Mountain Man accessories. (Sorry, cans not included.)



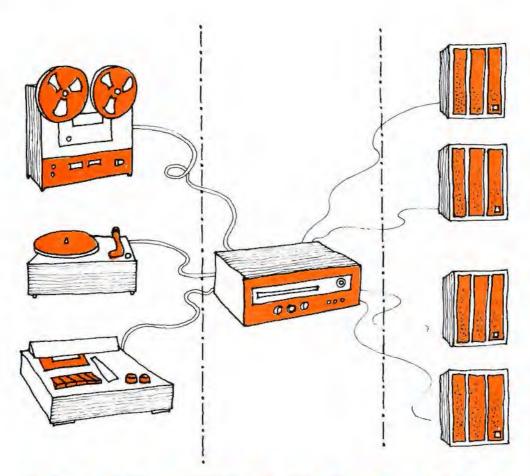
- Fits all externally mounted 14", 15" and 16.5" tires.
- Easy installation; all you need is a wrench.
- Made of rugged 11 gauge steel for strength and durability.

Winner of PV4 Magazine's 1976 Product Of The Year Award, it will score on your 4WD, van, pickup, or mini, and it's a steal at only \$39.95 F.O.B.

	DEL	TA	P	RO	DL	ICT	8, 1	NC.
, ,		elta V	Vav. D	ept.	PE, C	Grand J	unction,	
Please se ☐ Check ☐ Bank	anclos	ed. C	dle B harge	ag Ca my [rrier(☐ Ma	(s) @ \$: aster Ch	39.95 F. narge	O.B.
Credit Card #			П					
	Interba No.		ter Ch	arge o	กไรใ	Date		Year

I have enclosed \$2.00 for my comple Mountain Man catalog (to be applied ward my first purchase).	ete to-
Please rush free brochure on Mark 1 CDI Systems.	en

Name	
Address	
CityState	
Phone	Zip



HOW TO MATCH HI-FI COMPONENTS

Price tags serve as a good guide to apportioning dollars for each component.

ATCHING hi-fi components of a stereo or four-channel system means that each component must operate compatibly with each other.

For example, your loudspeakers should be efficient enough to deliver satisfactory sound levels—especially in the low bass region—when driven by the amplifier or receiver of your choice. Yet, they should have sufficient power-handling capacity to avoid damage if driven by too much power.

In another sense, compatibility also means that one component should not have substantially better performance than another component in the system. It would be foolish, for example, to have a \$300 single-play turntable, \$800 receiver, and two speaker systems at \$500 each and then add a \$19.95 phono cartridge. The latter's electrical/ mechanical performance would be well below that of the other components in the system. As a result, one would not get the full performance capability inherent in the better components. Remember that the final reproduced audio will sound only as good as the weakest component link in the system.

One can often ignore electrical and

mechanical considerations at the onset of rounding up his choices, however, by viewing compatibility in terms of each component's price tag. Thanks to competition among manufacturers, the quality of each type of component varies almost directly in relation to its price (although exceptions can always be found to virtually any generalization).

Most newcomers to component hi-fi (and some experienced audiophiles, too) have little or no idea of how to apportion their dollars to the various components they plan to buy.

Many audio dealers try to simplify this

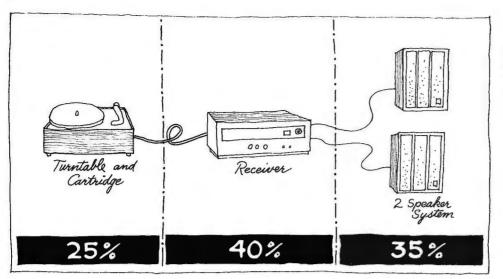


Fig. 1. Apportioning dollars to a stereo receiver/turntable/ speaker system.

problem by "assembling" pre-selected components into a complete system. Such systems usually bear a single price tag and offer significant savings over the prices of the individual components added together. There are both advantages and disadvantages in choosing such a dealer-selected system. Certainly, if the dealer is knowledgeable and reputable, you are at least

assured that the components which have been put together in this way will work compatibly with each other—and the savings in making a single purchase from one source are often worthwhile. On the other hand, you may have different ideas about which components you think sound better with which other components. Consequently, your dream system may not be represented by any

of the pre-selected groupings offered by the dealer.

In addition, it is common practice for some dealers (but not all) to have loud-speaker systems "custom designed" by local manufacturers who are essentially cabinet makers rather than speaker system designers. Since such speakers are rarely advertised nationally, almost any "suggested retail price" can be assigned

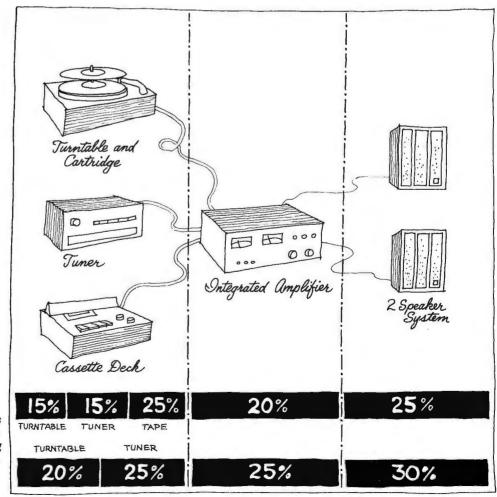


Fig. 2. Percentage of dollars to be spent on components for a system including tuner and cassette deck.

to them. In such instances, the "savings" shown in the final system price tag may actually be the result of reducing these speaker prices to more realistic levels. (This practice is not universal, of course.) What we are suggesting is that each component in such systems be analyzed and evaluated for its own mer-

fast rules; these are simply rough guidelines. In the system shown, any tape equipment would be considered extra and is not included in the initial percentage breakdown.

Suppose you decided to include a cassette deck as part of your initial hi-fi investment, and that you prefer to have

quality. In Fig. 3 we have represented a typical quadraphonic system centered around a 4-channel receiver. Again, percentages are shown below for each element of the system. If we assume that you are prepared to spend \$3000 for such a system (note that it includes both an open-reel tape deck and a stereo

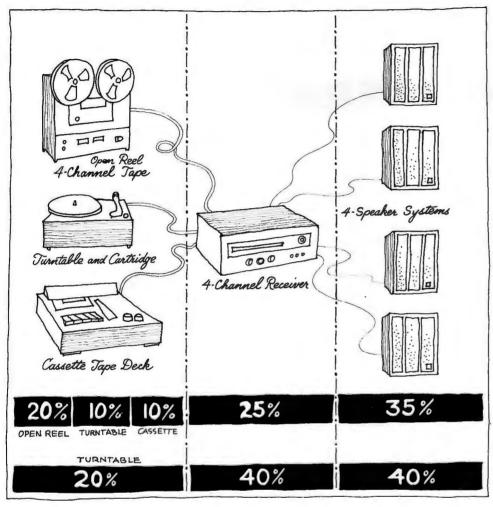


Fig. 3. How dollars should be apportioned for a four-channel system with open-reel and cassette decks.

its and performance—for that is the essence of shopping for components for your own high-fidelity system.

Apportioning Hi-Fi Dollars. By far the greatest number of high fidelity stereo component systems consist of an all-in-one receiver, a turntable system (either single-play or multiple-play) and a pair of loudspeaker systems. This basic layout is shown in Fig. 1. Below it is a typical cost breakdown in percentages of available dollars. As an example, if you have \$500 to spend on such a basic system, you might consider a turntable (including the phono cartridge, which is usually purchased separately) selling for approximately \$125, a \$200 receiver and two speakers for about \$87.50 each. There are, of course, no hard-anda separate tuner and an integrated amplifier (preamplifier-amplifier combination) instead of a receiver. Your system might then look something like that shown in Fig. 2, with the percentages spent for each component given below. Since such a system is necessarily more expensive than the simpler, 4-piece arrangement, let's start with a budget of \$1000. You might spend \$150 for a turntable and cartridge, \$150 or so for a separate FM/AM tuner, \$250 for a cassette deck with Dolby, \$200 for an integrated amplifier and perhaps \$125 for each of your two speaker systems. If the tape deck is eliminated for the moment, percentages could be reassigned as shown in the lower percentage table.

Quadraphonic systems necessarily cost more than stereo systems of equal

cassette unit) your dollars might be apportioned as follows: \$600 for the openreel deck, \$300 for the cassette deck and a similar amount for the turntable/ cartridge combination (you will need a cartridge designed to play CD-4 records this time), \$750 for the 4-channel receiver and \$262.50 for each of the four speakers in the system. If you were to omit the tape decks and had only \$2000 to spend, the lower percentage table in Fig. 3 suggests that you might spend \$800 on the 4-channel receiver, \$200 for each of the four speakers needed, and up to \$400 for the turntable/cartridge combination.

Specs To Expect. Although specifications are certainly not the only criterion involved in making an intelligent



Print Your Heart Out.

With help from the Digital Group, naturally.

Now, that small computer system you own or have been considering for personal or business use suddenly becomes a lot more usable—with the addition of a full-size *impact* printer from the Digital Group. A printer designed for small computers that need big output (like yours).

With the Digital Group printer, you can print your heart out...and it won't cost an arm and a leg. The Digital Group printer is available for less than \$500. That's right—\$500.

Just look at these specifications:

- Fast—120 characters per second
- 96 characters per line
- 12 characters per inch horizontal
- 6 lines per inch
- · Makes up to 4 copies simultaneously
- Character set and pitch variable under software control—double width characters, etc.
- 5 x 7 character matrix
- Ribbon has built-in re-inkers for a life of 10,000,000 characters
- Paper can be either a standard 8½-inch roll, fanfold or cut page
- Interfaces to 8-bit parallel ports

There are lots of capabilities and outstanding features of the Digital Group printer...and (as always) the best news is our price. Kit prices start as low as \$495 for the printer and interface card. It simply can't be beat.

Find out all the facts about the Digital Group printer now. Just fill in the coupon below or give us a call for the details. We think you'll find a place for our printer in your system ...and in your heart.

The digital group

P.O. Box 6528 Denver, Colorado 80206 (303) 777-7133

Quick. I want to print my heart out. Send me all the details on your full-size impact printer.

Name _____

City/State/Zip_____

Be the "New Professional" in electronics

CREI trains you at home for one of the most important career levels in electronics—plus offers you special arrangements for engineering degrees

Most people think there are only two levels of careers in electronics: the technician level and that of the degree engineer.

There is, however, a third and very important level. It is that of the engineering technician or *practical* engineer. The growing importance of this career level has created what might well be called the "New Professional" in electronics.

If you look at the various levels of employment in electronics, you will understand why this "New Professional" is so important.

The average technician is a person who has had vocational training in electronics. He understands the basic principles of electronics so he can trouble-shoot, repair and maintain equipment. He usually works under close supervision in performing his duties.

The engineer has college training in electronics. He usually supervises technician personnel and is responsible for planning and developing of electronic equipment and systems. Frequently, however, engineers are more heavily trained in the scientific principles of electronics and less in their practical application.

The engineering technician, by contrast, is a specialist in the practical application of electronics. His training usually consists of a two-year college program in electronic engineering technology. In many organizations, the engineering technician handles several of the responsibilities of the degree engineer. He often has the title of engineer.

CREI programs are designed to give you at home the same level and depth of training you receive in a two-year college program in electronic engineering technology. CREI programs are, in fact, more extensive than you will find in many colleges. And CREI gives you the opportunity to specialize in your choice of the major fields of electronics.

Unique Design Lab

CREI gives you both theory and practical experience in circuit design with its Electronic Design Laboratory Program. The professional equipment included in this program allows you to construct, test out and correct the circuits you design until you have an effective circuit.

This Lab Program helps you understand advanced electronics. It also gives you practical experience in many other important areas of electronics, as in pro-

Career Training at Home

totype construction, breadboarding, test and measurement procedures, circuit operation and behavior, characteristics of electronic components and how to apply integrated circuits.

Only CREI offers the unique Lab Program. It is a complete college Lab and, we believe better than you will find in most colleges. The "Lab" is one of the factors that makes CREI training interesting and effective. And the professional equipment in this program becomes yours to keep and use throughout your professional career after you complete the training.

Engineering Degree

CREI offers you special arrangements for earning credit for engineering degrees at certain colleges and universities as part of your home study training program. An important advantage in these arrangements is that you can continue your full time job while "going to college" with CREI. This also means you can apply your CREI training in your work and get practical experience to qualify for career advancement.

Wide Program Choice

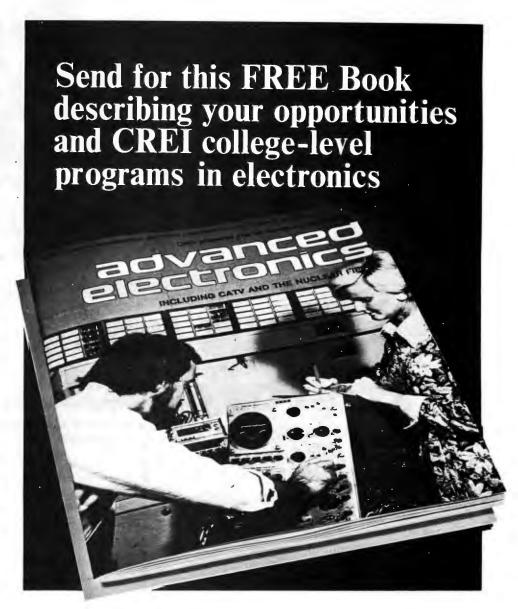
CREI gives you a choice of specialization in 14 areas of electronics. You can select exactly the area of electronics best for your career field. You can specialize in such areas as computer electronics, communications engineering, microwave, CATV, television (broadcast) engineering and many other areas of modern electronics.

Free Book

In the brief space here, there isn't room to give you all of the facts about CREI college-level, home study programs in electronics. So we invite you to send for our free catalog (if you are qualified to take a CREI program). The catalog has over 80, fully illustrated pages describing your opportunities in advanced electronics and the details of CREI home study programs.

Qualifications

You may be eligible to take a CREI college-level program in electronics if you are a high school graduate (or the true equivalent) and have previous training or experience in electronics. Program arrangements are available depending upon whether you have extensive or minimum experience in electronics.



Mail card or write describing qualifications to



McGraw-Hill Continuing Education Center 3939 Wisconsin Avenue Northwest Washington, D.C. 20016

Accredited Member National Home Study Council

GI Bill

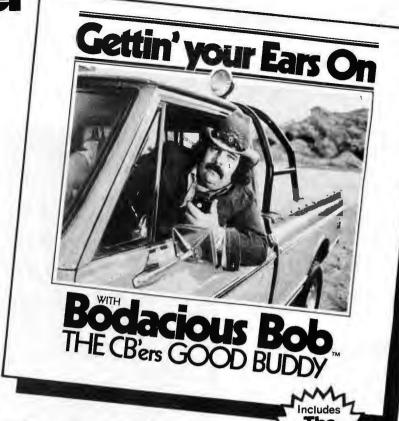
CREI programs are approved for training of veterans and servicemen under the G.I. Bill.



EVERY CB'er NEEDS A GOOD BUDDY.

NOW HE'S HERE!





BODACIOUS BOB

and his first album of CB songs & stories.

GET A COPY ON BODACIOUS.

He has somethin' to say to all CB'ers—old or new.

- · The history and future of CB
- The hottest new CB slang from around the country
- · City CB'n
- · Country CB'n
- · How to get the max out of your rig
- · CB courtesy, safety, theft prevention and fun
- · Shakin' the "CB Jeebies"
- · The sunspot "crisis"
- The Trucker's Prayer
- · Gettin' into The Squelch Squad

PLUS - 2 ORIGINAL CB HIT SONGS!

- "On the Road"
 (the story of a once-lonely trucker)
- "Get a Copy"

 (with impersonations of famous people talkin' on their CB's)

Plus other original music, from country to rock. And lots more! Order yours today!

Available on LP, 8-track, or cassette.

P1977 Audio Products, Inc.
 20969 Ventura Blvd., Woodland Hills, Calif. 91364
 1977 Audio Products, Inc. All Rights Reserved

10-4 Bodacious. You're talkin' on my channel. Send me
LP(s) @ \$6.95
8-track tape(s) @ \$7.95
cassette tape(s) @ \$7.95
Total of order:
(Check or money order please) (Calif. residents add 6% sales tax.) Charge to mv:
3 /-
☐ BankAmericard #
or Master Charge #
Exp. Date
Signature
Name
Address
City
StateZip
Mail orders to: BODACIOUS BOB
Box 1020 · Woodland Hills, Ca. 91364

	Low Price	Medium Price	High Price
Tuners Integrated	up to \$150	\$150-350	Over \$350
Amplifiers	up to \$200	\$200-400	Over \$400
Receivers	up to \$250	\$250-500	Over \$500
Turntables (Less Cartridge)	up to \$125	\$125-250	Over \$250
Cassette Decks Open-Reel Tape	up to \$200	\$200-400	Over \$400
Decks	up to \$400	\$400-800	Over \$800

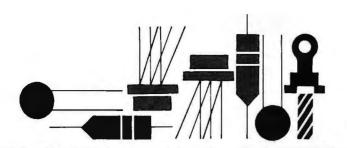
choice of a hi-fi component, they certainly have a bearing on the type of performance you can expect from each component. The specifications which apply to loudspeakers (and, for that matter, headphones) are not easily related to the kind of sound you can expect to hear. Aside from making certain that the speakers you select are efficient enough to provide adequate sound levels when matched with the electronics of your

choice, and also rugged enough to handle maximum input power available, choosing loudspeakers is a wholly subjective exercise. The specifications of other components, such as tuners, amplifiers (or receivers, which combine both tuner and amplifier sections), turntable system, and even tape decks are related to their prices. Table I categorizes low-, medium-, and high-priced electronic components, tape decks, and

turntable systems in terms of actual 1977 dollars.

With these price ranges in mind, refer to Table II for a general idea of the major specifications you can expect to find for components in each of the price categories. Only the major specifications have been listed, and they are by no means the only ones that should be considered. Remember, too, that you are likely to find that some specifications are better than others for a given product in a given price category. Your evaluation process should take these differences into account, along with your own particular needs. For example, what appears to be a superb tuner in its price class may otherwise have less-than-superb selectivity. If you live in an area where there are only a few FM stations on the dial, this may be of little significance to you, whereas greater sensitivity or 50 dB quieting may be more important. Conversely, if you live close-in to strong signals and are surrounded by a great many nearby stations, selectivity could be more important than sensitivity.

TABLE II TYPIC	AL SPECIFICATIONS O	F SOME COMPONENTS	t
	LOW PRICE	MEDIUM PRICE	HIGH PRICE
TUNER (OR TUNER			- Address of the same of the s
SECTION OF RECEIVER)		DELL N	
IHF Sensitivity μV (dBf)	3.0 (14.7)	2.0 (11.2)	1.8 (10.3)
(mono)	or lower	or lower	or lower
50 dB quieting sensitivity	form the state of		
μV (dBf), mono/stereo	10(25.2)/50(39.1)	5(19.2)/40(37.2)	3(14.7)/30(34,7
S/N (dB); mono; stereo	60/50	68/60	70/65
Selectivity (dB)	50 or more	60 or more	80 or more
Capture Ratio (dB)	3.0 or less	2.0 or less	1.3 or less
THD (%) (1 kHz, mono/stereo)	1.0/1.5 or less	0.5/0.8 or less	0.2/0.3 or less
Stereo Separation (dB, 1kHz)	30 or more	35 or more	40 or more
AM Suppression	40 or more	50 or more	60 or more
AMPLIFIER (OR RECEIVER AMP			
SECTION)		The second second	
Power Out/Channel			
(Continuous watts)	10-30	30-100	over 100
Rated THD (at full output) (%)	1.0 or less	0.5 or less	0.2 or less
Rated IM Distortion (%)	1.0 or less	0.5 or less	0.2 or less
Damping factor	10 or more	30 or more	50 or more
Phono Hum (dB below 10 mV input)	60 or more	65 or more	70 or more
Aux Hum (below rated output)	70 or more	75 or more	80 or more
TURNTABLE SYSTEMS			
Wow-and Flutter (% Wrms)	0.15 or less	0.10 or less	0.05 or less
Rumble (dB, per Din B)	55 or more	60 or more	70 or more
CASSETTE DECKS			The Part
Frequency Response (Hz ±3dB)	50-12,000	30-15,000	20-18,000
Wow-andFlutter (% Wrms)	0.2 or less	0.12 or less	0.1 or less
S/N (dB, less Dolby)	45 or more	48 or more	50 or more
OPEN-REEL DECKS			
Highest Speed (ips)	7%	71/2	15
Freq. Response at highest speed	-		
(Hz ±3 dB)	40-15,000	30-20,000	20-21,000
S/N	50 or more	55 or more	60 or more
Wow and Flutter	0.15 or less	0.1 or less	0.07 or less



Solid State

By Lou Garner

VMOS—MOSFETS WITH MUSCLE

ENERALLY, MOSFET's have been characterized as low-voltage, low-power, very high-impedance devices suitable for preamps, mixers, i-f amplifiers, detectors and other low-level applications. Where moderate power levels were needed, one used bipolar devices or dual-technology IC's such as the BiMOS op amp discussed in last month's column. About mid-1976, however, Siliconix, Inc. (2201 Laurelwood Road, Santa Clara, CA 95054), introduced the first member of a new family of medium-to-high-power MOSFET's, Manufactured using a unique internal structure, the new devices featured output currents measured in amperes rather than milliamps and power ratings specified in watts rather than milliwatts while retaining the advantages of more familiar designs-extremely high input impedances and high forward transconductances. Unfortunately, the new MOSFET's were relatively expensive and in short supply when first introduced, limiting their potential applications at the consumer level. In less than a year, however, production has expanded, new, types have been announced, prices have dropped to within the reach of experimenters and hobbyists, and the devices are being stocked by a number of industrial electronics distributors.

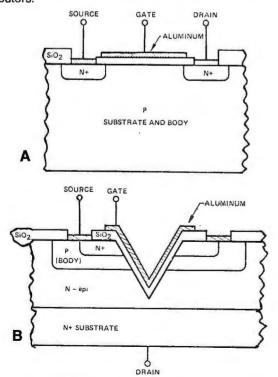


Fig. 1. Conventional MOS (A) and VMOS (B) cross-sections.

The basic differences in construction between conventional MOSFET's and the high-power Siliconix devices are illustrated in the simplified cross-sectional views given in Fig. 1. In a conventional device, Fig. 1A, a p-type semiconductor substrate serves as the basic body for the transistor. During the manufacturing process, n+ type source and drain areas are diffused into the p-type body. An insulating silicon dioxide layer is grown and aluminum electrodes for the source, drain and insulated gate terminals are deposited on the unit. In operation, the control channel is induced by the gate's electric field along the top surface of the substrate between the n+ regions, with current flow horizontally from source to drain. In the Siliconix design, Fig. 1B, an n+ semiconductor serves as the substrate and, eventually, as the drain electrode. An nepi layer is diffused above the substrate, with a p-"body" region and an n+ source subsequently diffused into this layer. The epi region effectively increases the device's drain-source breakdown voltage. In the next processing step, a V-shaped groove is etched through the source and "body" regions into the epi layer. An insulating silicon dioxide film is grown and the aluminum source and insulated gate electrodes are deposited on the device. In operation, the control channel is induced on both surfaces of the "body" region facing the Vshaped gate, with current flow vertically from the source through the control channel and epi layer to the substrate/ drain. Since the current flow is vertically through the semiconductor rather than horizontally across a surface, the transistor is called a "Vertical MOS" or VMOS device. The improved power handling capability of VMOS designs as compared to conventional MOSFET construction is due to several factors. including its higher drain-source breakdown voltage and greater current density, the latter a result of the effectively larger control region established by the two channels created on either side of the V-shaped gate.

Currently, all members of the VMOS family are n-channel enhancement-mode field effect transistors. A total of six devices are in production, divided into two series of three transistors each, but a third high-current (10 A) series is under development and should be available in the near future. All six devices feature high input impedances, zener diode protected gates to withstand static discharges, and short switching times (typically, 4 ns), permitting their use in r-f and vhf as well as audio and dc circuits. All are resistant to thermal runaway as well as secondary breakdown and are suitable for operation at temperatures from -55° to +150°C. Featuring output characteristics similar to those of a pentode vacuum tube, all types have typical transconductances of better than 250 millimhos.

Intended for medium-power applications and assembled in standard TO-3 packages, types VMP1, VMP11 and VMP12

have maximum drain current ratings of 2.0 A and can dissipate up to 25.0 W at case temperatures not exceeding 25°C, with a thermal derating factor of 5°C/W. Lower power types VMP2, VMP21 and VMP22 are assembled in TO-39 cases and have maximum drain current ratings of 1.5 A together with maximum power dissipation ratings of 4.0 W at case temperatures of 25°C and a thermal derating factor of 30°C/W. At ambient temperatures of 25°C, the lower power units have a maximum free air dissipation rating of 1.0 W. Types VMP11 and VMP21 have maximum drain-source and drain-gate voltage ratings of 35.0 volts, types VMP1 and VMP2 of 60.0 V, and, finally, types VMP12 and VMP22 of 90 V.

As long as maximum ratings and correct dc polarities are observed, VMOS transistors can be used in virtually all circuits for which standard MOSFET's and bipolar types are specified. Compared to conventional MOSFET's, the VMOS units offer the advantages of higher voltage and power capabilities coupled with greater resistance to damage from static discharges. Compared to bipolar types, the VMOS transistors offer much higher input impedances, faster operation, and

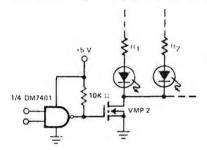


Fig. 2. VMOS application as a LED driver.

freedom from thermal runaway and secondary breakdown. Suggested VMOS transistor circuit applications are illustrated in Figs. 2 through 6. These were abstracted from the data sheets for the devices as well as from Siliconix Application Note AN76-3, a 12-page publication entitled VMOS-A Breakthrough in Power MOSFET Technology.

With its high input impedance, the VMOS transistor can interface directly with all types of logic circuits, including CMOS as well as TTL, serving as a power driver for such devices as magnetic cores, incandescent lamps, relays, solenoids and LED's. A typical multiple LED driver circuit is given in Fig. 2. Here, a 7401 TTL NAND gate serves as a signal source for the VMOS transistor which, in turn, drives a number of LED's. Suitable series current limiting resistors (R1, R2, etc.) are provided for each LED.

The dc incandescent lamp dimmer circuits given in Fig. 3 illustrate techniques for using the VMOS transistor as a control device. In the simpler and less efficient of the circuits, Fig. 3A, the transistor serves as a series element, with its drain-source resistance controlled by an adjustable gate bias. In operation, considerable power is dissipated in the transistor as the light is dimmed for the device behaves as a simple resistance.

The more efficient circuit, Fig. 3B, uses the VMOS transistor as a variable duty cycle switch which is either fully "on" or fully "off," thereby dissipating relatively little power. In operation, a pair of 34011 NAND gates serves as a pulse oscillator, with the feedback needed to start and sustain oscillation provided by a 0.001-uF capacitor. The oscillator's pulse symmetry is controlled by the ratio of the 100-k fixed resistor and 250-k potentiometer, with light-dimming achieved by changing the relative width of the on and off periods. If desired, the oscillator can be strobed by the application of a suitable bias to the first NAND gate, as shown, or the two inputs may be tied together for continuous operation.

SYSTEM 500

The New Programmable Clock Kit from Digital Concepts. \$29.95

SYSTEM 5000 is the programmable clock kit that makes kit-build-ing a new experience. The system has been designed to meet a var-lety of particular requirements and tastes, and programming techniques are used to create a truly individualized timeplece. Numerous functions and features are provided for maximum flexi-bility and adaptability, and any or all can be used to construct many different types of time-keeping and timing devices.

SYSTEM 5000 is not a simple LED time of day clock, but a full 575 EM 5000 is not a simple LED time of day cook, but a full feature digital timing system. Programming is accomplished by connecting the appropriate jumpers and switches to produce the desired system configuration. Complete assembly and program-

SYSTEM 5000 has a fluorescent readout panel with four 0.5" a rail the book as a hoosecent readout panel with how our numerals that brighten and dim automatically according to the ambient light. This unique digital display provides optimum read-ability at all times from almost any viewing angle.

ability at all times from amoust any verying single SYSTEM 5000 can be huift as a desk clock, slarm clock, calendar clock, or all of these in one full-feature (imperiece. The Duplicate Time Register can monitor elapsed tume or another Time Zone such as GMT. A time innute "I'D" reminder capability is included for Radio Station use. A quart time base is available for high precision. rupted operation if the AC line sho SYSTEM 5000 can automatically control AC or DC accessories up

RELAY OPTION - \$4.00

OUARTZ TIME BASE OPTION - \$6.95

Generates pricise 90 Hz. huffered output with exceptional stability, reliability, and accuracy. Direct interface to System 5000 and most Includes Quartz Crystal, IC Divider, trimmer, compact

ORDER THIS EXCITING KIT TODAY AND PUT ELECTRONIC TIMEKEEPING TD WORK FOR YOU!



to 700 Watts by adding the optional relay. Plug in your radio or stereo to construct a full function clock radio that outs you to sleen with gentle music and wakes you to music, a tone, or both. The system will also control TV's, small appliances, or other accessories

SYSTEM 5000 can be used to construct timers for a variety of applications. It is ideal for automatic process timers and controlli in laboratories, workshops, and engineering facilities.

SYSTEM 5000 includes all components, speaker, two time setting switches, and comprehensive instruction and programming manual

FEATURES AND SPECIFICATIONS

Timekeeping Functions

s 700 watt relay and all interface

nts Will control

- General
 Forward or Reverse Time Setting
 Reset and Count Inhibit Controls
 Seconds Display
 Single 9 Volt Battery Backup
 700 Watt Relay Optional
 50 or 60 Hz, 117Vac, 3 Watts
 1 5"H x 4"W. x 4"D.

SWITCH OPTION - \$3.75

Contains 4 black SPST pushbuttons, 2 black DPDT pi and 2 black SPST slide switches. Programs all major fea CASE OPTION — \$11,00

This deluxe; hand finished solid walnut (3/8") cabinet forms an ideal housing for the completed system. Includes rear panel and standard blue faceplate, extra faceplates (blue or green) are \$1.00 ca. Cabinet dimensions — 5%" x 5%" x 3".







Saddle Brook, New Jersey 07662 • (201) 845-7101

fabulous **Phi-Deck** family of 5 cassette transports under\$100 in quantities of 10



Featuring:

- · Die-cast frames
- · Remote controllable
- · Precise, fast head engage/disengage
- Quick braking
- · Search FF/rewind 120 ips
- · Speed ranges from .4 to 20 ips

Electronic packages and mag heads for most applications

For application in:

- 1. Micro processing
- recording/logging/storage
- 3. Programming
- 4. Instrumentation
- 5. Industrial Control 6. RS232 Data storage
- 7. Security/automatic warning systems
- 8. Test applications
- 9. Audio visual/education
- 10. Telephone interconnect
- 11. Hi-Fi
- 12. Point of sale

4605 N. Stile	s P.O. E	of the Economy Co. 3 ox 25308 ahoma 73125 (405) 521-9000
☐ I am interested in a	pplicati	ion no
☐ Have Representative	e call	☐ Send application notes
Name		Title
Company Name		
Address		
City	_ State	2 Zip
Phone Number		

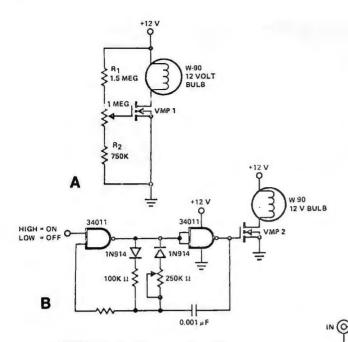


Fig. 3. VMOS light dimmer circuits: (A) Continuous (analog) control; (B) Pulse-width switched type.

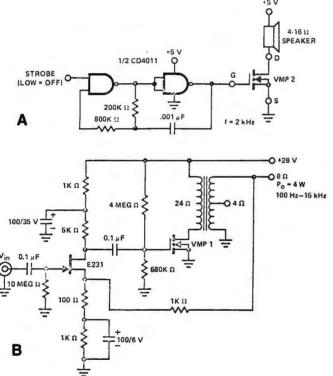


Fig. 4. VMOS audio circuits: (A) Alarm; (B) Class A amplifier.

Two of many possible audio circuit applications for VMOS transistors are illustrated in Fig. 4. The first, Fig. 4A, is a simple sound source which may be used in intrusion and fire alarms or similar projects. The design features a NAND gate oscillator similar to the one used in the second lamp dimmer circuit, with the VMOS transistor serving as a power driver for a PM loudspeaker.

The second, Fig. 4B, employs a single VMOS transistor as a Class A linear power amplifier in conjunction with a JFET preamp stage. Suitable for use in radio receivers, TV sets,

record players, intercoms, and low-power PA installations, the circuit can deliver 4 watts to a suitably matched loudspeaker load and has a reasonably flat frequency response from 100 Hz to 15 kHz. Overall distortion is kept to within 2% (at 3 W output) by 10 dB of inverse feedback provided by a 1-k resistor between the output and the preamp's source electrode. A 28-volt dc supply is required.

With their fast switching characteristics, VMOS transistors are suitable for many high-frequency projects. A typical linear vhf amplifier circuit is illustrated in Fig. 5. Designed for operation in the 144-to-146-MHz band, the design may be used in both transmitter and receiver applications. As a transmitter power amplifier, the stage has a minimum power gain of 12 dB and can deliver 5 W PEP at 146 MHz. If used as a receiver r-f preamp, the design can furnish 11 dB gain with a low noise factor of only 2.4 dB. All resistors are half-watt types and the coils are hand-wound, with T1 consisting of 8 turns of #24

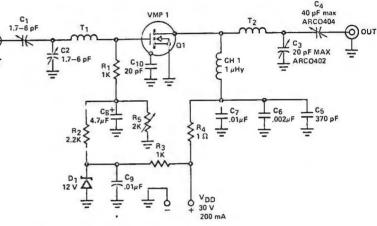


Fig. 5. Vhf linear amplifier using a VMOS transistor.

AWG, ½-in. diam., close-wound, and T2 of 5 turns of #24 AWG, ½-in. diam., close-wound. In common with most vhf designs, careful layout and proper lead dress during assembly are essential for optimum circuit performance.

A further example of the VMOS transistor's versatility is found in the high-power audio amplifier circuit shown in Fig. 6. Of potential interest to audiophiles and more advanced experimenters, the design is suitable for use in high-quality stereo or quadraphonic systems. Capable of delivering 40 watts to an 8-ohm load, the amplifier has an essentially flat closed-loop frequency response (exclusive of the r-f input filter) from 1 Hz to 1 MHz and a slew rate of better than 100 V/us. Its total harmonic distortion at 1 kHz, full rated output, is less than 0.05%. Featuring a Class AB quasi-complementary push-pull output stage using three parallelled VMOS transistors in each arm, the circuit is described in detail in Siliconix Design Aid DA76-1, The MOSPOWERTM FET Audio Amplifier. In addition to the schematic diagram and a suggested do power supply circuit, the 4-page publication includes pc board and chassis layouts, response curves, signal waveforms, construction and adjustment hints, and a detailed parts list.

Reader's Circuit. Both early and contemporary design concepts are combined in the interesting AM broadcast band receiver circuit illustrated in Fig. 7. Submitted by William J. Wolf (3543 Dubarry Rd., Indianapolis, IN 46226), the circuit features a *reflex* front-end, an IC op amp audio amplifier and a Darlington power output stage. Old timers probably will re-

Top quality devices, fully functional and carefully inspected. Guaranteed to meet all specifications, both electrically and mechanically. All are made by well known American manufacturers, and all have to

pass manufacturer's quality control procedures. These are not rejects, not fallouts, not seconds. In fact, there are none better on the market! Count on Radio Shack for the finest quality parts.



TIL Digital ICs

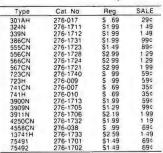
First Quality Devices Made by

Type	Cat. No.	Reg.	SALE
7400	276-1801	\$.49	29¢
7402	276-1811	\$.49	29¢
7404	276-1802	\$.59	29¢
7406	276-1821	\$.69	39¢
7408	276-1822	\$.49 \$.59 \$.69 \$.49	29¢
7410	276-1807	\$.49	29¢
7413	276-1815	\$1.19	69¢
7420	276-1809	\$.49	29c
7427	276-1823	\$.49 \$.69	39¢
7432	276-1824	\$.69	39¢
7441	276-1804	\$1.59	89¢
7447	276-1805	\$1.99	89¢
7448	276-1816	\$1.99	89¢
7451	276-1825	\$.49	29c
7473	276-1803	\$.49 \$.79	39¢
7474	276-1818	\$.79	39¢
7475	276-1806	\$1.19	69¢
7476	276-1813	\$.79	49¢
7485	276-1826	\$1.59	99¢
7486	276-1827	\$.69	49¢
7490	276-1808	\$1.19	69c
7492	276-1819	\$1.19	69c
74123	276-1817	\$1.69	89¢
74145	276-1828	\$1.49	1.19
74150	276-1829	\$1.79	1.39
74154	276-1834	\$1.79	1.19
74192	276-1831	\$1.69	99¢
74193	276-1820	\$1.69	99¢
74194	276-1832	\$1.69	1 19
74196	276-1833	\$1.69	1.19

	74C a	nd 4000 Serie	S CMOS	ICs .
_	74C00	276-2301	\$.69	39¢
	74C02	276-2302	S .69	39¢
	74C04	276-2303	S 69	39c
	74C08	276-2305	\$.69	39¢
	74C74	276-2310	\$1 29	59¢
	74C76	276-2312	\$1.59	69c
	74C90	276-2315	\$2.29	99¢
	74C192	276-2321	\$2.49	1 29
	74C193	276-2322	\$2.49	1 29
	4001	276-2401	\$ 69	39¢
	4011	276-2411	\$ 69	39¢
	4013	276-2413	\$1.29	89c
	4017	276-2417	\$2.49	1 49
	4020	276-2420	\$2 49	1 49
	4027	276-2427	\$1 29	89¢
	4049	276-2449	\$ 99	69¢
	4050	276-2450	\$.99	69¢
	4511	276-2447	\$2.69	1 69
	4518	276-2490	\$2.49	1 49

Linear ICs

First Quality Devices by National Semiconductor and Motorola

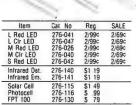


祖母祖祖祖祖田田

8080A Microcomputer Chip

Direct Plug-In Replacement for Intel 8080A

LEDs/Optoelectronics



Digital Displays



Anod Cath

Digits



\$2.99 \$2.99 4/\$8.97 4/\$8.97 \$3.99 \$3.99

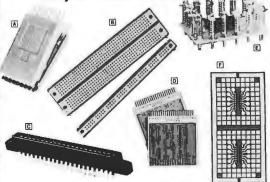


Juniani

276-060

Digits	Size	Onve	Cat. No.	Reg.	SALE
3	0 120	Cath	276-055	\$1 49	99¢
5	0.110	Cath.	276-059	\$1.99	1.49
9	0.150	Cath	276-060	\$2.99	1.99
4	0.5"	Anod	276-1201	\$9.95	7.95
4	0.5"	Cath	276-1202	\$9.95	7.95

Project Accessories



IC Troubleshooting Test Clip. Test up to 16 pm
with probes or clips 276-1951 4.9
Experimenter Socket. 2x47 rows of 5 connecte
tie points 276-172
Bus Strip. 2x40 connected the points. Clips to
socket above 276-173 1.9
© 22-Pin Edge-Card Board Connector. 44
terminals 276-1551 2 9
terminals 276-1551 . 2.9 Standard Edge-Card Board . 22-pin 1295 moun
no holes 276-152
ing holes 276-152 2.9 2-Voltage Source Edge-Card Board, 136
mounting boles 276-154 2 0
mounting holes 276-154
9 3-voltage Source Enge-Caro Duate. 130
mounting holes 276-153 2.9 E Salderless IC Experimenter Kit. For 8, 14
Soldeness IC Experimenter Att. For 6, 14 1
16-pin IC's. 277-101 2.5
Experimenter's PC Board, Mount 2 IC's, 8, 14
16-pin. 276-151
© Plastic Face Plates. 2x6x1/1"
Brown Tint. 270-298
Red Tint. 270-299
Photographic PU Board Processing Rit. Comple
negative process 8 pieces
276-1560. Reg \$12.95 Sale 9.9



Transformers

Heavy-duty filament transformers with primaries designed to operate from 120 VAC at 60 Hz. Long, color-coded leads. All U.S.

made. 25.2 Volts (Center Terminal), 2 Amps. 24x214x27, 273-1512 4.99 12 Volts, 5 Amps. 4x2x247 273-1513 8.95

273-1513. 8.95 18 Volts (Center Terminal), 4 Amps. Ideal for 5V (using CT), or 12V sohd-state regu-lators. 4x2x2½*, 273-1514 ... 8.95

Selected Diodes

Туре	Cat. No	Reg.	SALE
1N4001	276-110	1 2/\$.39	2/290
1N4003	276-110	2 2/\$.59	2/390
1N4004	276-110	3 2/\$.69	2/490
1N4005	276-110	4 2/\$.79	2/590
1N4735	276-561	2/\$.89	2/690
1N4739	276-562	2/\$.89	2/69¢
1N4742	276-563	2/\$.89	2/690
1N4744	276-564	2/\$ 89	2/690
1N5401	276-114	1 2/\$.69	2/59¢
1N5402	276-114	2 2/\$.89	2/690
1N5403	276-114	3 2/\$.99	2/790
1N5404	276-114	4 2/\$1.19	2/890
1N914/4	148 27	6-1122	10/990



SCRs and Triacs

Device	Rating	Cat. No.	Reg.	SALE
SCR	50V. 6A	276-1089	9 S .99	69¢
SCR	100V, 6A	276-1090	\$1.29	79¢
SCR	200V. 6A	276-106	7 \$1.39	89¢
SCR	400V. 6A	276-1020	\$1.49	99¢
Triac	50V, 6A	276-1003	3 \$.99	69¢
Triac	100V, 6A	276-1002	\$1.29	79c
Triac	200V. 6A	276-100	1 \$1.39	89¢
Triac	400V, 6A	276-1000	\$1.49	99¢



Reference Books





semiconductors, 276-4001 , 1.99 Voltage Regulators, 62-1371 2.25

Low-Profile **DIP Sockets**



8-Pin. 276-1995.	Reg. 2 for \$.69	Sale 2/59¢
14-Pin. 276-1999.		
16-Pin. 276-1998.	Reg. 2 for \$1.19	Sale 2/99¢
28-Pin. 276-1997.	Reg. \$1.19 Each	Sale 99¢
40-Pin. 276-1996.	Reg. \$1.39 Each	Sale 1.19

Style May Vary from Photo

Encoded Computer Keyboard

Operates on the scan principle utilizing TTL logic. With repeat key, negative/positive going data valid strobe, latch outputs, shift and shift-lock capability. True/false ASCII outputs, 6 extra control keys. With all necessary parts, including TTL components. Does not include test jigs, optional features or case and hardware. See store sales persons for parts list. sales persons for parts list. 277-117. Complete Pkg. Sale 49.95

Reg 6779 4

WHY WAIT FOR MAIL DELIVERY? IN STOCK NOW AT OUR STORE NEAR YOU! OVER 5000 LOCATIONS IN NINE COUNTRIES

A TANDY COMPANY . FORT WORTH, TEXAS 76107



SPRING 1977

Heathkit products are known world-wide for quality, performance and VALUE. And no matter what your interest—there's a kit that's just right for you. Every Hasthkit product comes with a thorough step-by-step assembly manual that leaves nothing to chance, and all our kits are backed by and all our kits are backed by our famous "We won't let you fail" pledge. See all the exciting sectionic products YOU CAN BUILD YOURSELF right here in this catalog.



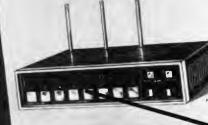
New

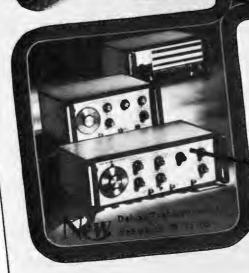
Deluxe Timing jght with Advance Meter and Tach See page 17



Aircraft Clock/Timer

3-Bon VHF-UHF Automatic soni enning Monitor





Programmable Home
Heating Control See page 44

New Amateur Radio Self-Learning HEATH

MAIL ORDER CATALOG

"Heath" and "Heathkit" are registered trademarks Heath (

01977 Heath Company See Index on page 3

Heath Company, Dept. 10-29 Benton Harbor, Michigan 49022

Some of the most exciting electronic kits ever to come along are is a deluxe Swept-Function Lin/Log Generator. The described in this NEW Heathkit Catalog.

NEW! AS-1348 deluxe Three-Way

Our biggest and best speaker system is designed for Speaker System use with the finest stereo components! Has a massive 15" woofer for bass response all the way down to 20 Hz; dual 41/2" midrange speakers for twice the power handling at the important middle frequencies, and a three-tweeter array that maintains dispersion and stereo image throughout any listening area. The AS-1348 provides "live performance" sound levels at ALL audible frequencies.

NEW! Electronic Circuits Learn-at-Home Course

The latest in our series of programmed learning courses — the Electronic Circuits Course provides an explanation of most common circuits and gives you the "hands-on" experience you need for circuit design and development. Covers amplifiers, power supplies, oscillators, pulse circuits, modulation and demodulation with emphasis on integrated circuits. Includes text material, audio records and 110 electronic parts for 18 different experiments with the op-

tional electronic trainer. NEW! GR-1132 3-Band VHF/UHF **Automatic Scanning Monitor**

Listen to ALL the action — automatically! Covers any combination of 8 crystal-controlled channels in the 30-50 and 146-174 MHz VHF bands, and 450-500 MHz UHF band, for police, fire, ambulances, Amateur 2meter FM, marine, emergency vehicles, U.S. Gov't weather stations and more. Has extra-large lighted channel indicators, priority channel feature and channel lockout buttons, built-in antenna for all three bands, provision for external antenna. Built-in speak-

er, volume and squelch controls. NEW! CI-1096 Deluxe Auto Timing Light with built-in Tachometer and Advance

The fast, easy way to keep tabs on your car's engine timing and distributor advance functions for smoother operating and better fuel economy. Single, compact unit houses a timing light, advance meter and tachometer. Measures up to 60° mechanical or vacuum advance from 1500 to 4500 RPM and indicates engine speed to 4500 RPM. Bright xenon flash tube lets you set timing even in daylight. Inductive pickup snaps around #1 sparkplug wire for easy hookup.

NEW! Advanced Test and

Three new test instruments will bring advanced service capability to any test or hobby bench. The IG-1275

IG-1273 is a voltage-controlled Lin/Log Generator, and the IG-1272 is a low-distortion audio frequency oscillator perfect for audio testing. All three offer professional performance and specifications at low

PLUS nearly 400 other superb, easy-to-build, moneykit-form prices. saving products. You'll find a complete line of digital electronic clocks and weather instruments, plus useful and unique items for your car, home or office.

Our learn-at-home courses are now in use by the thousands! A really effective and low-cost way to teach yourself about electronics for fun, for knowledge, or for profit. We also have a wide selection of popular books covering almost everything in electronics.

There are many more exciting products to read about too! Home convenience items like a practical freezer alarm, a touch-control light switch, intercoms and a unique programmable doorbell. Automotive instruments and accessories, marine equipment, model aircraft Radio Control gear, security systems and more. Plus our world-famous Amateur Radio equipment and test and service instruments.

These are among the nearly 400 quality, fun-to-build kits described in this new Heathkit catalog. Kits for every interest. All with the world-famous Heathkit assembly manual — a step-by-step instruction guide that makes kitbuilding easy and leaves nothing to chance. And all backed by our "We won't let you fail" promise. Find out about the satisfaction, savings and FUN of kitbuilding.

Send for your FREE copy today!

HEATH lumberger	Heath Company, Dept. 10-29 Benton Harbor, Michigan 49022
	- FREE Heathkit Catalog.
lease send man not on yo	our mailing list.
Vame	
Address	
Vadingo-	State
CHA	Zip

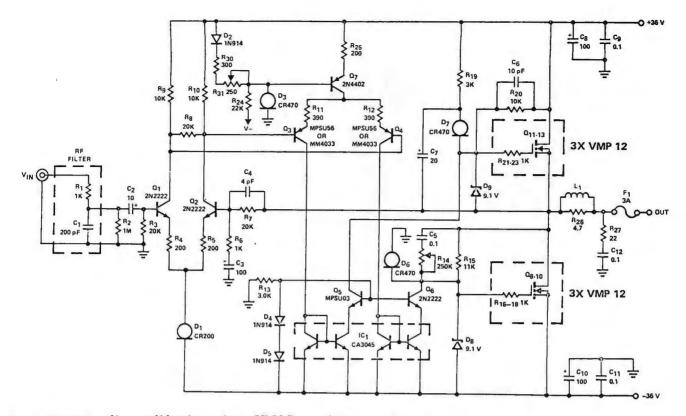


Fig. 6. 40-watt audio amplifier featuring a VMOS transistor output stage.

member the reflex circuit concept with a touch of nostalgia. Popular in the early to middle 50's, when good quality r-f transistors cost as much as fifty dollars each (pre-inflation dollars, at that!), the reflex citcuit permits a single device to amplify two different signals—r-f and audio—simultaneously.

In operation, r-f signals picked up and selected by tuned circuit *L1-C1* are applied to *Q1*, serving, initially, as an r-f amplifier. An amplified signal is developed across r-f collector load *L2* and coupled through *C3* to a detector network consisting of *D1*, *R2*, *D2* and r-f bypass *C2*. The resulting demodulated (audio) signal also is applied to *Q1*, now serving as an audio amplifier and developing an amplified signal across the audio collector load, *T1*'s primary winding. The RFC (*L2*) acts virtually as a short as far as audio signals are concerned. The audio signal is next coupled through gain control *R3* and dc blocking capacitor *C4* to op amp *IC1*, which serves to drive the final power output stage, Darlington connected pair *Q2-Q3*. A PM loudspeaker, shunted by *R9*, serves as the output load. Inverse feedback is provided across the power output and driver stages through *R8* to minimize distortion and optimize over-

all performance. Reflex amplifier (Q1) base bias is furnished through R1, the op amp's offset biases through R5 and R6 with, finally, the Darlington receiving its base bias directly from IC1 through current limiting resistor R7, bypassed by C6. Circuit operating power is supplied by B1, controlled by S1.

Except for the hand-wound loop antenna coil, *L1*, William has specified standard, readily available components in his design. Transistor *Q1* is a general purpose pnp device similar to Radio Shack's type RS-101, *IC1* is one section of an inexpensive type LM3900 quad op amp, *Q2* and *Q3* are hobbygrade type 2N3055 npn power transistors, and *D1* and *D2* are general-purpose diodes similar to types 1N34 or 1N60. A 2.5-mH RFC is used for *L2*, while *T2* is a small 10-k to 2-k interstage audio transformer similar to Radio Shack's No. 273-1378. Tuning capacitor *C1* is a standard 365-pF unit and all other capacitors are low-voltage disc ceramics except for *C4*, which is a 15-volt electrolytic. The fixed resistors are all one-quarter or one-half watt types. Any standard PM loud-speaker with an 8- or 16-ohm voice coil may be used as the output device. The power switch, *S1*, is a spst toggle, slide or

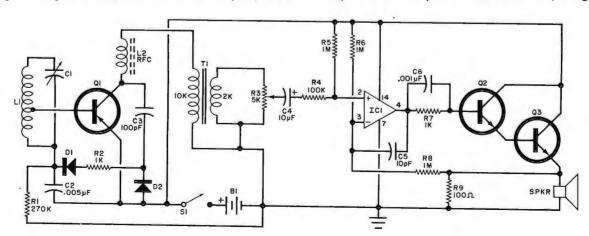


Fig. 7. Broadcast band receiver has reflex front end and IC op amp audio amplifier.

rotary type, with the power pack, *B1*, made up of six series-connected size "C" or "D" flashlight cells. William describes *L1* as a loop antenna consisting of 16 turns of #22 solid copper insulated hook-up wire tapped at 12 turns and close-wound on a wooden frame measuring 10 in. high by 13 in. long by 3 in. wide.

Although neither layout nor lead dress should be critical when duplicating the circuit, good wiring practice should be followed, with signal carrying leads kept short and direct, heat sinks provided for the power transistors (Q2 and Q3), and all dc polarities observed. The reader suggests that the entire circuit, including the loudspeaker and power pack, can be assembled conveniently within the wooden frame supporting the loop antenna. Depending on Q1's individual characteristics, some experimentation with R1's value may be required for optimum performance. Some hobbyists also may wish to experiment with the number of turns on the loop antenna coil or with C1's value to obtain coverage of other radio bands. If desired, a multiple tapped coil and suitable selector switch can be provided for multi-band operation.

Device/Product News. Suitable for use in instruments, audio systems, controls, and similar analog applications, a new low-cost dual operational amplifier with a unity gain bandwidth over 2.5 MHz has been introduced by *Motorola Semiconductor Products, Inc.* (P.O. Box 20912, Phoenix, AZ 85036). Designated types MC4558/MC4558C, the new devices are offered in round metal cases as well as in ceramic and plastic 8-pin MiniDIP's. Internally compensated, the new op amps feature a typical large-signal voltage gain of 200 V/mV at 25°C and a CMRR of 90 dB. The two amplifiers within each package are closely matched with respect to both gain and phase, and both are protected against load short circuits.

If your requirements are for a quad rather than dual unit, you should be interested in the RC/RM4156 announced recently by *Raytheon Semiconductor* (350 Ellis St., Mountain View, CA 94040). Supplied in plastic or ceramic 14-pin DIP's, the op amps are short-circuit protected and feature a minimum unity gain bandwidth of 2.8 MHz.

The Fairchild Camera and Instrument Corp. (LSI Group, 464 Ellis St., Mountain View, CA 94042) is now offering a new dynamic bipolar 4096-bit random access memory (RAM) designed for operation on a single 5-V dc supply. Two versions of the new RAM are in production. Both are organized as 4096 × 1 bits and have a power consumption of 350 mW active, 70 mW standby, and 500 mW in page mode. The standard 93481 has a maximum access time of 120 ns with a 280-ns cycle time, and a page mode access and cycle time of 75 ns. The faster version, type 93481A, has a maximum access time of 100 ns with a 240-ns cycle time, and a page mode access and cycle time of 65 ns. Manufactured using Fairchild's Isoplanar Integrated Injection Logic process, the new RAM's are TTL compatible and are supplied in standard 16-pin ceramic DIP's.

National Semiconductor Corp. (2900 Semiconductor Drive, Santa Clara, CA 95051) has developed a new single-chip IC containing a pair of monolithic npn transistors matched to within 50 μ V of each other. Identified as type LM194, the matched pair has a noise figure so low that it is virtually immeasurable and features a minimum current gain of 500, a current-gain match of better than 2%, a CMRR of better than 120 dB, and a low drift of less than 0.1 μ V/°C. With a maximum collector-emitter voltage rating of 40 V and a maximum power dissipation of 500 mW, the LM194 is supplied in a 6-lead TO-5 style metal case.

MIND-ABSORBING PROJECTS FOR ELECTRONIC EXPERIMENTERS AND HOBBYISTS



1977 ELECTRONIC EXPERIMENTER'S HANDBOOK

Helps you get it together with a score of build-it-yourself projects.

This latest edition includes a host of exciting construction projects for audio buffs—Audio-Controlled Detailed Power Shut Off; 9-Channel Steree Equalizer... For fun and games—FLIP, a CMOS Logic Game; Sound Effects with the 555 IC Timer... for experimenter's—ESP Testing Machine; How to Make Double-Sided PC Boards; IC Digital Logic Memory Probe... for computer/calculator; Microcomputer Primer; Bits-to-Dots Computer Video, There's a host of other projects including The Executive Digital Temper Countdowner • Versatile Nickel-Cadmium Battery Charger • Shirt-Pocket Metronome • Hall Effect Magnetometer • Low-Cost Metal Locater • 3-Way Photo Flash Tripper • The 99-cent Wonder IC • High-Yalue Electrolytic Capacitor Meter • Guitar Sound Intensifier • IC Photo Tachometer • R-F Transistor Tester • And more! PLUS: Microcomputer product buying guide and a basic digital logic course. All with complete construction plans, parts lists and printed-circuit board patterns. Many projects are unique designs not available elsewhere. Only \$1.85!

Ziff-Davis Publishing Co.
Consumer Service Division
595 Broadway, New York, N.Y. 10012
Please send the 1977 ELECTRONIC EXPERIMENTER'S
HANDBOOK. I'm enclosing \$1.85 (\$1.50 plus 35c
for postage and handling). Outside U.S.A. \$3.00,
postpaid.
Residents of Calif., Col., Fla., III., Mich., Mo.,
N.Y. State, D.C. and Tex. add applicable sales tax
(postage and handling charges non-taxable).
print name
address
city state zip

COMING UP IN THE JUNE

Popular Electronics®

SPECIAL FOCUS ON TEST INSTRUMENTS

DIGITAL IC TESTER PROJECT
BUYER'S GUIDE TO SCOPES
40-MHz DIGITAL FREQUENCY COUNTER
MILLIAMMETERS ON A BUDGET

POWER AND MODULATION CAPABILITY OF 40-CHANNEL CB TRANSCEIVERS

HOW TO PROGRAM CALCULATORS FOR FUN AND GAMES

BUILD A STATE-OF-THE-ART BATTERY CHARGE MONITOR



By Forrest M. Mims

USING LED'S AS LIGHT DETECTORS

IGHT emitting diodes have many applications including status indication, digital readout, signal isolation, and light-beam communication. But did you know LED's can also be used as light detectors?

You can easily demonstrate the pho-

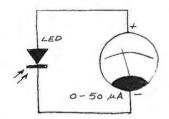


Fig. 1. Simple LED detector demonstration circuit.

tosensitivity of a LED by using the simple circuit in Fig. 1. An infrared emitting LED such as the Texas Instruments TIL32 is connected directly to the terminals of a 0–50 microampere meter. This forms a *photovoltaic* circuit, and when the LED is placed near a desklamp or other bright light source, the meter will indicate a photocurrent of at least 10 or 15 microamperes.

Though gallium-arsenide infrared emitting diodes make the best light detectors, visible emitters made from gallium arsenide phosphide, gallium phosphide, and other materials also work. For best results, use LED's with clear encapsulants. Remember that just as LED's emit a narrow spectrum of light,

they are sensitive to relatively narrow wavelength bands. Thus a green emitting diode will detect green light better than a red emitter; and infrared emitters will detect infrared far better than visible emitters.

LED's operated as detectors have several very practical applications. For example, an optoisolator can be made by mounting two infrared emitting diodes at either end of a short length of heat shrinkable tubing. The resulting op-

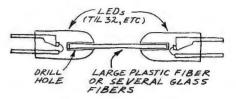


Fig. 2. LED-LED optoisolator using optical fiber coupling.

toisolator can then be used in either direction since the LED's can both emit and detect infrared.

You can also couple two epoxyencapsulated LED's with a short length of plastic or glass optical fiber. Just bore a small hole in the top of each LED, using care to avoid striking the chip or its

Treat yourself to a new direct reading DVM today.



DVM35

POCKET PORTABLE ANALOG REPLACEMENT 3-digit, 1% DCV Battery or AC Only \$134



DVM36

LAB ACCURATE POCKET PORTABLE 3½ digit, .5% DCV Battery or AC Only \$158



DVM32

BENCH & FIELD MASTER 3½ digit, .5% DCV Battery or AC

Only \$198



DVM38

"PRIME" STANDARD AT YOUR FINGERTIPS 3½ digit, .1% DCV Auto-Ranging Only \$348

A COMPLETE LINE OF DVMs TO FILL YOUR EVERY NEED OR WANT.

You can be sure more times in more circuits, under more adverse conditions, with greater versatility, accuracy, and meter protection than any other digital multimeters on the market today; and for less money, too. 10 Day Free Trial: Try any of these famous DVMs for 10 days. If the DVMs in use don't prove exactly what we say, return them to your Sencore FLPD Distributor.



Want more information? We would like to tell you all about the Sencore DVMs by sending you a 24-page Sencore News, a six-page brochure, and the name of your nearest Sencore Distributor today . . . simply write or circle reader's service number.

3200 Sencore Drive, Sioux Falls, SD 57107



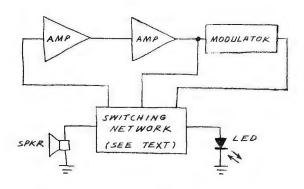


Fig. 3. Block diagram for single LED transceiver.

upper electrode wire. Then insert some clear epoxy, the fiber, and secure the fiber in place until the epoxy has cured. Figure 2 shows how two LED's are coupled together using this method.

Another possible application for a LED in the detector mode is to monitor the light intensity arriving from the sun or artificial sources at the face of a seven-segment LED display. An unused decimal-point LED could be used as the light detector for a circuit which could automatically control the brightness of the display.

The most intriguing application for

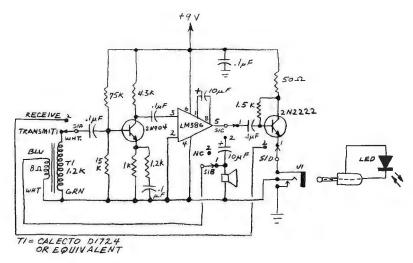
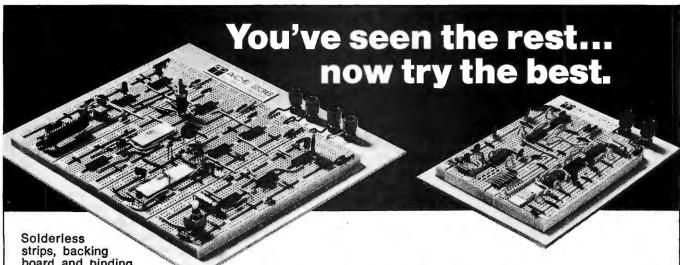


Fig. 4. Schematic diagram of a practical LED-LED transceiver.

LED's operated as detectors lies in the field of light-beam communications. One problem with light-beam communicators designed to operate through the atmosphere is optical alignment. (The *most* perplexing problem, of course, is the atmosphere itself.) Conventional light-beam communicators with separate LED transmitters and photodetector receivers must use two lens systems or complicated optics which allows both to use the same lens or lenses.

LED-LED communicators, however, need only one lens per transceiver. Then when the transmitter of one unit is aligned with the receiver of a second unit, the transmitter of the second unit is automatically aligned with the receiver of the first.

A Practical LED-LED Transceiver. The block diagram for a basic amplitude-modulated light beam transceiver using a single infrared LED as both a



board and binding posts. Everything you need to build and test your own circuit. Used to be you'd get a circuit idea, lay out a pc board, print it, solder everything together, trouble-shoot, change your layout, try a new board, and spend absolutely too much time breadboarding. Now A P ACE All Circuit Evaluators let you breadboard in a fraction of the time. Make your changes im-mediately. Keep full leads on your components. Avoid the heat damage possible with repeated soldering and de-soldering. A P made the first modern solderless breadboard, and we still make them best.

Pick an ACE for Faster and Easier solderless circuit building and testing.

Send for our complete A P catalog, The Faster and Easier Book.

Part No.	ACE Model No.	Tie Points	DIP Capacity	No. Buses.	No. Posts	Board Size (inches)	Price Each
923333	200-K (kit)	728	8 (16's)	2	2	4-9/16x5-9/16	\$18.95
923332	208 (assem.)	872	8 (16's)	8	2	4-9/16x5-9/16	28.95
923334	201-K (kit)	1032	12 (14's)	2	2	4-9/16x7	24.95
923331	212 (assem.)	1224	12 (14's)	8	2	4-9/16x7	34.95
923326	218 (assem.)	1760	18 (14's)	10	2	6-1/2x7-1/8	46.95
923325	227 (assem.)	2712	27 (14's)	28	4	8x9-1/4	59.95
923324	236 (assem.)	3648	36 (14's)	36	4	10-1/4x9-1/4	79.95

Order from your A P distributor today. Our distributor list is growing daily. For the name of the distributor nearest you call Toll-Free 800-321-9668.

AP PRODUCTS INCORPORATED

Box 110 Painesville, OH 44077 (216) 354-2101 TWX: 810-425-2250



source and a detector is illustrated in Fig. 3. The circuit consists of a preamplifier, amplifier, LED driver and a switching network to switch the LED from the input of the preamplifier (receive mode) to the output of the driver (transmit mode). Several years ago I described a LED-LED communicator patterned upon this basic design in Popular Electronics ("Communicate Over Light Beams with the First Single-LED Transceiver," March 1974, p. 66). While this transceiver worked quite well, it used a relatively large audio amplifier module.

Figure 4 is the circuit diagram for a more up-to-date LED-LED transceiver made with an LM386 audio amplifier IC. Thanks to the LM386, the new circuit is much smaller and somewhat simpler than the original version. Also, the new circuit incorporates a simplified one-transistor modulator, a single 8-ohm speaker which doubles as a microphone, and a 9-volt battery.

I have assembled a working version of the circuit in Fig. 4 and installed it in a miniature bakelite cabinet measuring 3-1/4" x 2-1/8" x 1-1/8" (8.26 x 5.4 x 2.86 cm). There isn't enough room here to include all the construction details, but here are a few assembly tips: Use a perforated board measuring 2" x 1-15/16" (5.08 x 4.92 cm) to leave room for the 9volt battery. Remove the upper two corners of the board to make room for the cabinet's cover screws. A 2" speaker fits perfectly in the space between battery and the upper end of the cabinet. All the components except the LED can be installed in a circle on the circuit board around the base of the speaker. The 4pdt switch fits between the upper two cover screw receptacles. Because of the limited space, the switch handle will have to emerge from the side of the cabinet opposite the front of the speaker.

Use a miniature phone jack to connect the LED to the circuit. Besides providing an automatic on-off switch, this will allow you to experiment with various kinds of LED's. It will also let you place the LED some distance from the circuit and simplify experimentation with different lenses.

I've used the transceiver in Fig. 4 for communications through the atmosphere and a fiber optic cable. Results with a 10-meter (32.8') length of glass fiber with an attenuation of a few hundred dB per kilometer were excellent. This cable should soon be available from some of the firms which specialize in experimenters' electronics components. Until then, you can try high-loss plastic fibers or stick to the atmosphere.

Hobby Scene

By John McVeigh

SUPPRESSING BLOWER HASH

Q. I built the CB converter described in the October issue and have installed it in a 1976 Plymouth Fury. However, the blower fan motor (for air conditioning, heating, and defrosting) creates so much static that it is impossible to operate it and the converter simultaneously. I do not have this problem when I use the AM/FM radio "straight through." Can you suggest a filter that will suppress this interference?—W. B. Grandjean, Baton Rouge, LA.

A. I recommend the installation of 0.25-μF coaxial capacitors across the terminals of each blower motor. The capacitor will act as a short circuit to the r-f hash generated by the sparking at the motor brushes, but will not affect the system from a dc point of view. The capacitors can be obtained from most auto supply houses, and can also be used to silence noisy gauges and sender units. Be sure that the case of the converter and the shield of the antenna lead-in are well grounded.

FM STATION LISTINGS

Q. I would like to obtain a listing of FM radio stations. Do you know where I could get one?—Mrs. Don Ginest, Lakin, KS.

A. As I recall, a very comprehensive list of FM broadcasters is offered by the Worldwide TV-FM DX Assoc., Box 163, Deerfield, IL 60015. Also, there's a listing in North American Radio-TV Station Guide, by Vane A. Jones, published by Howard W. Sams & Co.

NIXIE INTERFACE

Q. How can I trigger 170-volt Nixie tubes with the 12-to-14-volt "digit enable" pulse from a 5313 clock chip?— LeRoy Lee, Altus, OK.

A. I think the most inexpensive way to do this is to have the digit enable pulses turn on high-voltage npn switching transistors. These in turn would apply the high voltage to the individual tubes. A suitable transistor is the Motorola HEP S0027. It has a collector-to-emitter breakdown voltage rating of 300 volts, maximum collector current of 500 mA, and a typical cut-off frequency of 50 MHz. However, if you go this route, be sure to include current limiting resistors at the base and collector of each transistor. Of course, some chips provide BCD outputs which can be decoded by suitable IC decoder/drivers. For example, the 7441 is specifically designed for use with Nixies.

TTL VS. CMOS

Q. The circuit for the "Westminster Chime" clock (November 1976) uses CMOS IC's. Is it possible to use TTL IC's in place of them, or a mixture of the two?—Murray Voakes, Essex, Ontario.

A. Although similar CMOS and TTL gates and sequential logic circuits perform the same functions-a CMOS 2input NAND gate is logically equivalent to a TTL 2-input NAND-there are differences in input and output impedances, drive capabilities, operating voltages, etc. The great advantage of TTL over CMOS is operating speed. However, CMOS has it all over TTL in the areas of power consumption at slow speeds and noise immunity when higher operating voltages are used. In this application, switching speeds are low enough to allow CMOS to run significantly cooler than TTL. This means that a smaller power supply can be used. In fact, CMOS is becoming so popular that several manufacturers are offering MOS devices that have the same pinouts as the 7400 TTL series. This allows one to convert from TTL to CMOS with a minimum of pc board modifications. So I really don't see going TTL or hybrid in this circuit. Surplus CMOS is inexpensive, an all-CMOS design requires no level interfacing, and power supply demands are greatly reduced. As a final note, many CMOS devices are now zener diode "clamped" and won't self-destruct when you touch them!

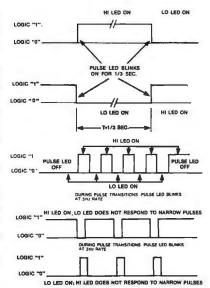
Logic Probe 1 is a compact, enormously versatile design, test and trouble-shooting tool for all types of digital applications. By simply connecting the clip leads to the circuit's power supply, setting a switch to the proper logic family and touching the probe tip to the node under test, you get an instant picture of circuit conditions.

LP-1's unique circuitry—which combines the functions of level detector, pulse detector, pulse stretcher and memory—makes one-shot, low-rep-rate, irrow pulses—nearly impossible to see, en with a fast scope—easily detectable and visible. HI LED indicates logic "1", LO LED, logic "0", and all pulse transitions—positive and negative as narrow as 50 nanoseconds—are stretched to 1/2 second and displayed on the PULSE LED.

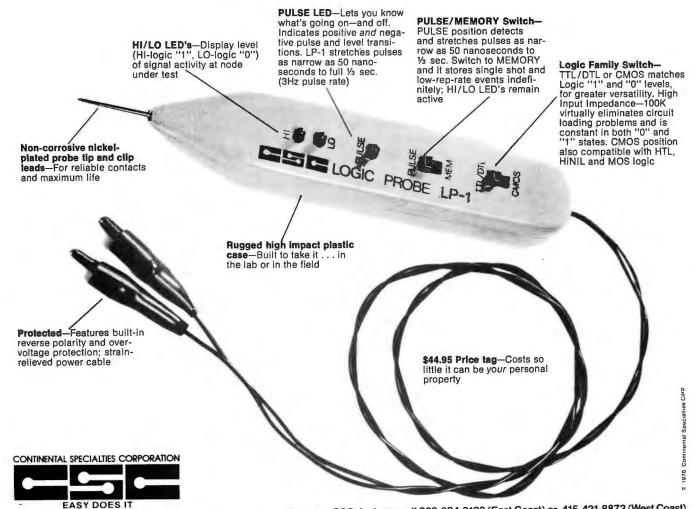
By setting the PULSE/MEMORY switch to MEMORY, single-shot events as well as low-rep-rate events can be stored indefinitely.

While high-frequency (5-10MHz) signals cause the "pulse" LED to blink at a 3Hz rate, there is an additional indication with unsymmetrical pulses: with duty cycles of less than 30%, the LO LED will light, while duty cycles over 70% will light the HI LED.

In all modes, high input impedance (100K) virtually eliminates loading problems, and impedance is constant for all states. LP-1 also features over-voltage and reverse-polarity protection. Housed in a rugged, high-impact plastic case with strain-relieved power cables, it's built to provide reliable day-in, day-out service for years to come.



CSC'S MULTI-FAMILY LOGIC PROBE 1. AT \$44.95, IT DIGS UP A LOT OF INFORMATION WITHOUT BURYING YOUR BUDGET.



44 Kendall St, Box 1942, New Haven, CT 06509 TWX: 710-465-1227 West Coast office: Box 7809, San Francisco, CA

West Coast office: Box 7809, San Francisco, CA 94119 TWX: 910-372-7992; Canada: Len Finkler Ltd., Ontario; Mexico: Elpro, S.A., Mexico City, 5-23-30-04

See your CSC dealer or call 203-624-3103 (East Coast) or 415-421-8872 (West Coast) 9 AM to 5 PM local time. Major credit cards accepted. Add \$2.50 for shipping and handling in the U.S. and Canada on direct orders of \$50.00 or less; \$3.00 for orders over \$50.00. On all foreign orders add 15% to cover shipping and handling.



KENWOOD MODEL TS-820 TRANSCEIVER

All-band hf transceiver has operating versatility and built-in speech processor.



LTHOUGH Kenwood's new Model TS-820 160 - through - 10 - Meter SSB/CW amateur transceiver physically resembles its popular Model TS-520, the two are very different in terms of circuit design and built-in features. Also, the TS-820 can accommodate an optional digital frequency readout, whereas the TS-520 cannot. Other new features (discussed later) clearly make the new transceiver Kenwood's "top of the line."

The transceiver is housed in a rugged. gray-finished cabinet that measures 13-3/16" D \times 131/8" W \times 6" H (33.5 \times 33.3 × 15.3 cm). A versatile (110- or 220-V. 50- or 60-Hz) ac power supply is built-in, as well as a small loudspeaker. A handle on the right side of the cabinet provides a means for carrying the 35.2lb (16-kg) transceiver. The basic TS-820 transceiver is priced at \$830. The optional DG-1 digital frequency readout, which mounts inside the TS-820's cabinet and can be added at any time, is \$170. Other options include CS-820-20 500-Hz CW crystal filter (\$45), the DS-1A dc/dc converter for mobile use (\$59), and the VFO-820 extemal vfo (\$139).

General Description. The transceiver circuitry is solid state, except for a 12BY7A driver and two S-2001A (a pinfor-pin 6146B equivalent) final amplifier tubes. The usual complement of transmitter and receiver tuning controls is provided. The multi-function, switch-controlled meter indicates final amplifier

plate current or voltage, relative r-f output, alc circuit operation, compression level from the built-in r-f speech processor, and S units.

When the MODE switch is set to TUN or FSK, power input to the finals is automatically reduced so that the tubes' rated plate dissipation is not exceeded. The r-f speech processor is activated by pulling out the COMP LEVEL/PROC control. The amount of the compression (indicated on the meter) is adjusted by rotating this control.

The transmitter pi network and transceiver preselector controls are grouped together. The PLATE tuning control uses a vernier for easy adjustment. The LOAD control is concentric with a FIX CH switch that selects any one of four crystal-controlled channels in the FIX mode (crystals optional).

The center-detented IF SHIFT control is concentrically paired with the receiver incremental tuning (RIT) control, the latter activated by a pushbutton. The CW CAR level and SSB MIC gain controls are also paired, as are the RF GAIN and AF GAIN controls. An RF ATT push-button switch inserts a 20-dB attenuator at the receiver's antenna input to combat overload and desensitization by strong local signals.

The BAND switch has positions for all amateur bands between 1.8 and 29.7 MHz, as well as JJY/wwv (reception only) on the 15-to-15.5-MHz band. The 10-Meter band is covered in four 500-kHz segments. (There is also a position on the BAND switch labelled AUX, which

apparently can be used for operations outside the regular ham bands, although the manual does not mention it.)

The FUNCTION switch is normally left in the vFo position to allow the internal vfo to control the transceive frequency. When set to FIX, both frequencies are controlled by internal crystal oscillators, with up to four frequencies selectable by the FIX CH switch. The VFO:R position uses the internal vfo to control the receiver's frequency, while the FIX:R position puts the receiver under crystal control and the transmitter under vfo control. When either the transmitter or the receiver is on vfo control, the FIX and RMT positions are used with the AUX crystalcontrolled channels of the remote vfo to zerobeat the vfo to channel frequency.

A separate HEATER switch is provided to shut off the tube heaters when the transceiver is used for reception only. All VOX controls are mounted on the front panel for ready access. Because the VOX circuit controls the changeover relay on CW (semi-break-in) as well as SSB, it is most convenient to have the DELAY control up front for easy adjustment as conditions warrant.

The large tuning knob operates two circular dial scales, one calibrated at 1-kHz intervals (numbered every 10 kHz), and the other calibrated at 50-kHz intervals and numbered from 0 to 500 every 100 kHz. The dial index can be moved to calibrate the scale against the 25-kHz marker oscillator or WWV. The dial setup uses Kenwood's "mono-scale" kilohertz dial system which fits the full 500-kHz tuning range on a single small dial with 1-kHz calibration intervals. The scale is rotated 10 turns for edge-to-edge coverage of each band segment.

When the optional digital frequency display is installed, as it was on our test model, the fluorescent readout appears in a window above the mechanical dial scales. Above the numeric display are four LED's that indicate when the ATT (attenuator) is on and when FIX, VFO, and RIT functions are active.

A button labelled DH (display hold) permits the numeric display to be "frozen" to store a frequency for quick retuning. When the display is frozen, you can tune about using the mechanical dial. To return to the original frequency, you simply note the counter display, release the DH button, and tune until that number again appears in the display.

The single-conversion receiver has an 8830-kHz i-f. A phase-locked-loop (PLL) circuit gives the benefits of both single and multiple conversion with few of the disadvantages of either. The local oscil-

lator consists of 11 separate band-switch-selected voltage-controlled oscillators or vco's (one for each band). These oscillators employ varactor diodes. The output of the vco is heterodyned with a crystal oscillator to produce a frequency between 3.33 and 3.83 MHz. The heterodyne oscillator also consists of 11 separate oscillators. The 3.33-to-3.83-MHz signal is then heterodyned with the output of a crystal-controlled carrier oscillator operating near 8830 kHz to generate an output between 5.0 and 5.5 MHz.

Tuning is by a conventional 5.0-to-5.5-MHz, highly stable and linear Clapp vfo. The vfo's output is compared with a down-converted vco signal by a phase comparator whose output trims the output frequency of the vco. Thus, the vco is phase locked to the 5.0-to-5.5-MHz tunable oscillator to effectively transfer the linearity and stability of the latter to the 10.5-to-39-MHz local oscillator. A phase-lock sensor disables the vco if PLL action fails, preventing off-frequency operation.

There are two separate carrier oscillators. One, controlled by two switchable crystals, operates on SSB transceive and on CW receive. The other functions in the transmit FSK and CW modes, when the receive and transmit frequencies are slightly separated.

A very useful feature is the IF SHIFT, which allows the i-f passband to be moved approximately ± 1.7 kHz without affecting the pitch of the received signal. The IF SHIFT electronically varies the frequency of the carrier oscillator in the PLL system. This causes the vco to move exactly as much as the carrier frequency, resulting in no net change in the relationship between the signal and oscillator frequencies. Because the filter is fixed, the signal is moved through the filter passband.

The built-in r-f speech processor provides up to 50 dB of compression. Here's how it works. The audio input signal is applied to a balanced modulator operating at 455 kHz and is then passed through a filter to remove one sideband. The remaining sideband is compressed—not limited—by an agc amplifier. It is further filtered to remove distortion products beyond the desired modulation passband, down-converted to audio, and finally applied to the main balanced modulator of the transmitter.

Some 10 dB of r-f negative feedback is used in the driver and output stages to reduce odd-order IM products by 6 to 10 dB. This makes the signal unusually clean and free from splatter that could



10-W avg. output with sustained "Ahhh" driving transmitter.



Average power increased to 40 W with 20 dB of compression.

interfere with QSO's on nearby frequencies. Alc is also used to prevent driving the output tubes into nonlinearity.

The transceiver has a built-in SSB receiver that is always tuned to the transmitter frequency so the operator can monitor his transmitted signal. R-f is sampled just before the driver stage, heterodyned down to audio by a product detector, and injected into the receiver's audio amplifier when the MONITOR switch is on. This is a good way to determine the effects of the r-f processor and to determine how much background noise is increased when compression is introduced.

The optional digital frequency display module counts the frequency to the nearest 10 Hz, then rounds off and displays the operating frequency to the nearest 100 Hz. Accuracy of the display is guaranteed to be 1 ppm/month.

Transmitter Tests. On 80 Meters, a two-tone test resulted in 200 W PEP input to the final amplifiers. PEP output into a 50-ohm dummy load was 115 to 120 W. Key-down CW input power measured 165 W, and CW output 100 to 110 W. On SSB, carrier suppression varied from 53 dB (LSB) to 58 dB (USB). The unwanted sideband was 60 dB down when a 1000-Hz modulating signal was applied. Distortion products measured as follows: third order -32 to -34 dB referenced to the two tones, -38 to -40 dB referenced to PEP; fifth order -56 dB referenced to the two tones, -62 dB

referenced to PEP. An audio input of 1 mV at 1000 Hz was sufficient to fully modulate the transmitter on the 7-MHz band.

The r-f speech processor produced some interesting results. A sustained "Ahhh" driving the transmitter to full PEP yielded an average power output of 10 W when no compression was applied. With 20 dB of compression (as indicated on the transceiver's meter), the average power output increased to 40 W. Peak power remained at the same level with or without compression. This translates to a 6-dB increase in "talk power," equivalent to an increase of one "ideal" S unit at the receiving end. This increase is nearly equivalent to switching in a 1000- or 1200-W PEP linear.

Of course, the processor (like all processors) introduced some a-f distortion and degraded the unwanted sideband suppression. At a modulating frequency of 1000 Hz, and at 10 dB of compression, the second harmonic of the modulating frequency was 30 dB down-equivalent to 3.2% of distortion. Unwanted sideband suppression measured 50 dB. At 750 Hz, the second harmonic measured -28 dB (4% distortion) when 10 dB of compression was introduced. The third harmonic (2250 Hz) was 20 dB down (10% distortion), and unwanted sideband suppression measured 30 dB. When a 500-Hz tone was used to modulate the transceiver, the unwanted sideband suppression improved to -35 dB. Finally, when a 400-Hz modulating tone was applied, the second harmonic measured -40 dB (1% distortion) at 10 dB of compression. The third harmonic was 10 dB down (32% distortion), and the unwanted sideband suppression measured 25 dB.

Alc action was very good. Flat-topping simply did not appear, even at maximum alc. Audio response measured (at the 6-dB points) 325-2800 Hz (USB) and 240-2700 Hz (LSB). When the speech processor was used, the response was slightly altered. Maximum VOX release time was approximately one second. When the release was shortened to allow semi-break-in CW keying, no shortened first dot or dash occurred. That is the exception, rather than the rule, among today's amateur rigs!

To check the transceiver's frequency stability (rated at better than 100 Hz/hour after a one-hour warmup and less than 1000 Hz of drift in the first hour after a one-minute warmup), the transceiver was attached to a dummy load and placed in the TUNE mode at 7 MHz, yielding an r-f power output of about 15

Frequency (MHz)	Sensitivity (μV) for 10 dB (S+N)/N		Image Rejection (dB)	I-f Signal Rejection (dB)	Band-to-Band Gain* (dB)
	SSB	CW			
1.8	0.1	0.05	96	100	. 0
3.5	0.1	0.063	92	90	-3
7	0.08	0.05	86	96	0
14	0.1	0.056	70	92	-3.5
21	0.1	0.063	66	96	-3
28	0.1	0.063	68	96	-1
					(+1 dB on
					29.5-MHz
					segment)

*Overall gain—not affecting sensitivity—determined by comparing audio output on each band, referenced to 1.8 and 7 MHz, produced by a given input signal. Variations in band-to-band gain occur below the agc threshold and have no effect above it.

W. The frequency of this output signal was measured by coupling a frequency counter to the dummy load. After a brief stabilization period (much less than the allowable hour), the drift averaged about 96 Hz/hour for the next few hours. The final transmitter test we performed was the measurement of r-f harmonics at the antenna output jack. They were consistently 40 dB below the fundamental.

Receiver Tests. Results of our measurements of sensitivity, image rejection, i-f signal rejection, and difference in band-to-band gain appear in the Table. Note that sensitivity measurements at these very low signal levels are usually accurate to within ±3 dB. However, even within this margin, the TS-820's receiver tested extremely "hot." A 50-µV signal (nominal) was required for an S9 meter reading; a 1-μV signal produced an S2.5 reading. Inserting the r-f attenuator in the input line (by means of the front panel pushbutton) dropped signal levels 20 dB. The receiver incremental tuning varied the receive frequency ± 3000 Hz. Unwanted sideband rejection measured 60 dB at 1000 Hz and 50 dB at 500 Hz.

No crossover birdies were found when signals below 10,000 µV were applied to the input. Internal spurious signals measured 0.2 µV (equivalent) at 21.200 MHz and less than 0.1 μV (equivalent) at 2 and 21 MHz. Two 320-µV signals (-57 dBm, or 70 dB above the SSB sensitivity) spaced 25 kHz apart created third-order IM (intermodulation) products equivalent to the rated sensitivity (0.1 µV for 10 dB (S+N)/N). An undesired 32,000-μV (-17 dBm) signal 110 dB above a 0.1-µV desired signal desensitized the receiver by depressing the desired signal 1 dB. The receiver section was very resistant to blocking (overload). No loss of output level or increase in distortion was detected when input signals of up to $100,000 \,\mu\text{V}$ (-7 dBm) were applied.

When the r-f input signal varied from 0.1 to 1 μ V (a 20-dB change), the audio output rose 18 dB. When the input signal was raised from 1 μ V to 10 μ V, the agc came into play and the audio output rose only 1 dB. A 100-dB change in r-f (from 1 to 100,000 μ V) caused the audio output to increase only 2 dB. Release time from an S9 signal level to full recovery was approximately 0.75 second when the agc switch was in the FAST position and 4.5 seconds in the sLow mode.

Nominal overall response—which included the i-f passband and audio responses-measured as follows: 400 to 2150 Hz at -6 dB, 200 to 3525 Hz at -60 dB (USB); 275 to 1850 Hz at -6 dB, 75 to 3300 Hz at -60 dB (LSB); 700 to 1250 Hz at -6 dB, 335 to 1685 Hz at -60 dB (CW). These measurements were made below the agc threshhold. The differences between USB and LSB are easily explained by the fact that the frequency of the carrier oscillator feeding the balanced modulator is deliberately shifted for proper generation of USB and LSB signals. It is the change of the relationship between the skirts of the fixed crystal filter and this carrier oscillator that causes different overall responses in the USB and LSB modes. However, in both modes the unwanted sideband suppression was 60 dB at 1000 Hz and 50 dB at 500 Hz.

The transceiver produced 1.5 W of audio output into 8 ohms. A 1000-Hz sine wave was used for this test, and at the start of clipping total harmonic distortion was less than 2%.

In our final receiver test, we applied a pulse train composed of 0.0005-µs-wide pulses at a 60-Hz rate. This pulse train

(at 100 dB above 1 μV/MHz bandwidth) completely obliterated a 3-μV input signal. A 10-μV signal was depressed by at least 10 dB due to agc capture by the noise pulses. However, when the TS-820's noise blanker was activated, normal agc action was restored and undisturbed copy of even 0.1-μV signals became possible! But the blanker had no effect on low-level pulses (less than 50 dB above 1 μV/MHz bandwidth).

On The Air. With few exceptions, we confined our on-the-air testing to the 7-MHz band. Operation was equally divided between SSB and CW. During the weeks we operated this transceiver, we never felt the need to use our linear.

It seemed as natural to scan the bands with the digital numeric frequency display as it was to observe the position of a dial scale against an index line. Let us assure anyone who is not ready to make the added investment in the digital display that the mechanical dial is accurate to within about 100 Hz of the digital display.

We were pleased to note that the transceiver can be tuned with its own meter, and modulated within the maximum limits defined by its alc meter scale without compromising performance. The front-panel VOX controls proved to be rock stable. On CW, the delay could be set so that the transmitter would drop out between characters below 20 wpm and between words at higher speeds. This is not really QSK (full break-in keying), but it's pretty close! Both the keying and modulation received numerous unsolicited compliments from stations contacted. Only rarely useful on SSB, the IF SHIFT proved to be valuable on CW. It let us move QRM off the skirts of the 500-Hz filter to the point of inaudibility, without changing the pitch of the desired signal.

During our tests, an idling truck blanketed us with ignition noise at S9. Switching in the noise blanker effectively eliminated—not just reduced—the interference! This was a most impressive demonstration, which left us regretting that the blanker could not dispose of types of noise other than impulse noise.

In actual QSO's, we verified that the r-f speech processor gave a one to two S-unit improvement in signal strength. However, the processor does cause some signal distortion. Thus, the processor should be used (and is intended for use) only under conditions that warrant it. Under strong-signal conditions, all speech processors impair intelligibility to some degree. On the other

hand, when the going gets tough, a good processor like the one in this transceiver can make the difference between contact and no contact.

No sound at all could be heard from the transceiver's cooling fan. The "silent" fan's cooling effectiveness was undeniable, however. After almost two hours of either SSB or CW operation, the cabinet was cool to the touch everywhere except directly above the final tubes, where it was faintly warm.

The TS-820 is certainly a full-feature all-band ham transceiver. The only gripe we do have concerns the top-facing speaker, which managed to lose much

of its meager output in our acoustically treated ceiling. For fixed-station operation, the owner would do well to connect an external speaker to the rear-panel output jack.

In sum, the TS-820's versatility and fine performance and the obvious top craftsmanship that has been spent on its design will fill any ham with pride of ownership. If we had to pick the most attractive feature among so many admirable ones, it would be the "digital hold." With this "memory" function, we'll never again fail to return exactly to a QSO frequency after a brief listen off-channel.

CIRCLE NO. 103 ON FREE INFORMATION CARD

MURA MODEL PRX-100 "PRM" CB MICROPHONE

Peak-redistribution modulation effectively increases signal power.



HE MURA PRM microphone contains a conditioning system that redistributes the asymmetrical sharp-peak portions of speech to make the signal more symmetrical. At the same time, it also holds down the peaks to allow the lower-energy components of the signal to be effectively higher in energy than would be possible with a "straight" microphone. This peak-redistribution modulation (PRM) is accomplished electronically by delaying the large sharp-peak components of the signal for minute amounts of time in relation to the lowerenergy signals before passing them on to the transmitter's modulator. The result can be an effective average modulated signal without adverse distortion.

One of the new PRM microphones for CB use is the push-to-talk Model PRX-100. It has a gain control for setting up the optimum output level for any particular CB transmitter according to the operator's voice amplitude. (The microphone cannot be used with certain CB transceivers on the market. These are

detailed by manufacturer and model on the card on which the microphone is packaged.) Operating impedance is 0 to 2500 ohms. Power for the microphone system is obtained from an internal 9volt battery. Price is \$39.95.

Test Results. We checked the Model PRX-100 with the aid of a dual-trace oscilloscope to observe simultaneously the output of the transducer cartridge and the conditioned output signal from the PRM circuit. Asymmetry at the cartridge was demonstrated with the maximum sharp-peak excursions in the positive direction. The conditioned output still produced some asymmetry, but in the opposite direction and to a lesser degree. However, the peak ratios, compared to the in-between lower-energy components, were reduced sufficiently to permit an overall higher average output level which potentially increased the average power of the modulated signal.

We also made comparisons with other microphones and with different voices. We noted that less improvement was obtained when compared to the output of the poorer-quality microphones than was the case with better units. (Lowerquality, less-expensive microphones usually exhibit their best symmetry, with lower positive/negative-peak ratios.) It should be noted that the advantages gained by using a PRM microphone apply mostly to limited-level amplifying or modulating systems in which operation is below the overload or clipping level. Systems that employ clippers or some form of automatic modulation control (amc) generally tend toward symmetry and higher average signal levels.

The "Click and Pop" machine

only by



Ever since the invention of the recorded disc annoying "clicks" and "pops" caused by scratches, static and imperfections have consistently disturbed the listening pleasure of music lovers.

Now, SAE introduces the unique model 5000, an Impulse Noise Reduction System which eliminates those unwanted sounds with no adverse effect on the quality of the recorded material.

This breakthrough in electronic circuitry is so demonstrably effective that the SAE 5000 is destined to become an essential part of any sound system.

The SAE 5000 is compact and sleek, built to SAE's exacting standards, and ready to enhance the performance of any system, from the standard receiver/turntable combination, to the most sophisticated audiophile components.

SAE is proud to add the 5000 to their broad line of *Components for the Connoisseur*.

-	Scientific Audio Electronics, Inc. P.O. Box 60271, Terminal Annex Los Angeles, Cal. 90060
	Please send more information on the 5000.
1	Name
i	Address
-	City
1	State Zip PE-577

CIRCLE NO. 53 ON FREE INFORMATION CARD

Empire's Blueprint For Better Listening

No matter what system you own, a new Empire phono cartridge is certain to improve its performance.

The advantages of Empire are threefold.

One, your records will last longer. Unlike other magnetic cartridges, Empire's moving iron design allows our diamond stylus to float free of its magnets and coils. This imposes much less weight on the record surface and insures longer record life.

Two, you get better separation. The small, hollow iron armature we use allows for a tighter fit in its positioning among the poles. So, even the most minute movement is accurately reproduced to give you the space and depth of the original recording.

Three, Empire uses 4 poles, 4 coils, and 3 magnets (more than any other cartridge) for better balance and hum rejection.

The end result is great listening. Audition one for yourself or write for our free brochure, "How To Get The Most Out Of Your Records." After you compare our performance specifications we think you'll agree that, for the money, you can't do better than Empire.

ÊMPIÆ

Already your system sounds better.

Empire Scientific Corp. Garden City, New York 11530 The polarity and characteristics of the existing microphone, as well as the frequency response or phase shifts in the modulating system, play an important role as to whether or not any significant improvement can be obtained with the use of a PRM microphone with a given degree of maximum modulation.

We noted that the low-frequency response of the microphone was somewhat less than usual. This resulted in a slightly crisper signal for better intelligence under adverse conditions.

User Comment. In many situations, with the gain control of the microphone set at maximum, the output level can be high enough to severely overload the modulator. This can produce heavy clipping or overmodulation, the latter beyond the signal-handling capabilities

of an amc system. Although the use of the microphone can make a signal sound somewhat louder, it may possibly do so at the price of high distortion and excessive adjacent-channel splatter. Therefore, caution should be taken in setting the microphone's gain. This is best done while observing the modulated r-f waveform on an oscilloscope and setting the level control so that the signal does not cause excessive or distorted modulation.

Whether or not a change to this type of microphone will be of benefit in any particular case can be determined by listening to the CB signal under maximum-modulation conditions. (The Model PRX-100 is rated to deliver up to a 4-dB increase in average modulated power, which we confirmed.)

CIRCLE NO. 104 ON FREE INFORMATION CARD

B&K PRECISION MODEL 1471B OSCILLOSCOPE

Has dual-trace and trigger functions desirable in testing modern circuits.



GOOD general-purpose oscilloscope for servicing and electronics experimenting should have a linear triggered sweep with a broad selection of sweep rates and triggering sources. It should also have two independent traces to permit observation of both the input and output signals of a circuit under test. Moreover, its vertical amplifiers should have sufficient bandwidth and sensitivity to enable the user to work with high-frequency signals with very low and very high amplitudes. The vertical amplifiers should be dc coupled to permit the scope to double as a voltmeter, and both amplifiers should have identical characteristics to permit the instrument to be used for a vector display. Finally, if the scope is to be used in TV servicing, it should have provisions for frame and line sweeps to serve as a vectorscope for chroma alignment.

All of these characteristics can be found in B&K Precision's Model 1471B dual-trace oscilloscope.

The scope measures 16"D \times 9.6"W \times

7.7"H (40.4 \times 24.5 \times 19.6 cm) and weighs 18 lb (8.2 kg). Price is \$495.

General Details. Each of the vertical amplifiers in this dual-trace solid-state oscilloscope has a bandwidth that goes from dc to at least 10 MHz, risetime of 35 ns, 3% or less overshoot and ringing with a 100-kHz square-wave input, and 1 megohm paralleled by 22 pF input resistance. The deflection factor of the vertical amplifiers is from 0.01 volt/cm to 20 volts/cm in 11 calibrated ranges, fully variable between range settings.

Either amplifier (trace) can be selected separately, or the scope can be operated in the dual-trace (simultaneous display of both channels) mode. In the dual-trace mode, the traces are chopped at a 200-kHz rate at all sweep rates up to 1 ms/cm, while alternate-trace operation is automatically switched in for all faster sweep rates. Channel separation in the dual-trace mode is better than 60 dB at 1000 Hz.

The sweep circuit shared by both

channels can be automatically triggered without an input signal to the scope. The sweep range is from 1 $\mu s/cm$ to 0.5 s/cm, with full variability between ranges. In addition, the sweep can be magnified 5×, yielding a maximum sweep speed of 0.2 s/cm. There is less than 3% (typical) horizontal linearity distortion.

The switch-selectable sweep triggering can be either internal or external and from the channel in use. (Channel A is selected in the dual-trace mode.) At almost all levels, either the positive or the negative slope of the input signal can be selected to initiate the triggering. Alternatively, the triggering can be automatic. The sweep can be triggered from 20 Hz to better than 10 MHz in the internal mode (1-cm deflection on the CRT's graticule) or dc to 10 MHz from an external trigger signal. A built-in sync separator is provided to permit observation with high stability of any portion of a complex TV waveform.

The horizontal amplifier can be accessed through the channel-B connector on the front panel of the scope and is selected by one position on the sweep speed control when the instrument is in the vectorscope mode. The horizontal amplifier then has a deflection factor of from 0.01 volt/cm to 20 volts/cm, which is the same as that of the vertical amplifier, and a frequency response from dc to 1 MHz.

Intensity modulation on the Z axis is available via a TTL-compatible connector on the rear panel of the scope. A logic low increases trace brightness, while a logic high decreases the brightness. The input resistance to the Z axis is 10,000 ohms.

The scope features a 5" (12.7-cm) flat-screen CRT. Over the face of the CRT is an 8 × 10 cm blue-colored engraved graticule. The bezel that holds the graticule in place can be removed easily to allow insertion of the vector overlay needed for color TV alignment. A 1-volt p-p square-wave source permits checking and calibration of the vertical amplifiers without having to use external sources.

User Comment. The Model 1471B oscilloscope is an excellent general-purpose instrument. Calibration was originally performed with a very accurate external voltage source. After operating the scope for six hours a day over a period of two weeks, we again calibrated the scope and found it to be still "on the head."

During our in-service tests, we deter-

mined that the scope's sync holds up under even very-low-level and relatively high-frequency signals. The trace was steady, and we experienced no trace break-up in the chop mode. The light blue color of the graticule was very easy on the eyes and permitted relatively long term waveform observation without causing optical fatigue.

All controls on the scope are clearly identified, the knobs are shaped and sized for comfortable user "feel," and the controls have positive, smooth action. The combination tilt stand/carrying

handle features a solid locking mechanism in both the carry and tilt positions.

During our tests, we used a pair of optional No. PR-31 combination 10:1/direct probes (\$25) that proved to be excellent for general-purpose work. They feature miniature spring-loaded clip-tips that enable use in circuits where terminals are very tightly spaced.

If you need fast risetime, extended bandwidth, critical circuit timing, and accurate and stable waveform viewing, the Model 1417B is an excellent choice.

CIRCLE NO. 105 ON FREE INFORMATION CARD

An exciting, new magazine!

Personal Computing

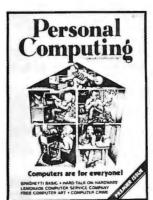
If you don't have your own computer by now, chances are there's one in your immediate future. Personal computers are now being sold at about the price of home stereo systems. Experts project that 1,000,000 personal systems will be up and running by 1980.

PERSONAL COMPUTING will serve as your guide into this exciting new technology. We'll provide you with all the up-to-date information on new computer products, computer clubs, computer stores, and important personal computing events. In addition, each issue contains easy-to-follow, nontechnical articles on computer programming and computer jargon. These articles illustrate how you can use personal computers at home, school, and work.

Get your FREE issue now

Fill out the subscription form below, and we'll send you a complimentary copy. If you don't agree that Personal Computing is everything we say it is, simply write "Cancel" on the invoice and return it to us. If you do want to subscribe, simply pay the bill. In any case, the first issue is on us!

A one year subscription to PERSONAL COMPUTING is just \$8.00



ı

, _ ,	I KIND IN THE
I understand that the first	
	ed is my check for \$
☐ BankAmericard ☐ Ma:	ster Charge 🗌 Am Express
Credit Card #	
Credit Card Expiration D	ate
Name (print)	
Address	
City	
State	Zip
Note: PERSONAL COMPL	UTING is a bi-monthly ear). Rates: \$8/year in the

United States. Mexico and Canada: \$10 surface mail

and \$12 airmail. All others: \$26 airmail.

PERSONAL COMPUTING/167 Corey Road, Brookline, MA 02146, USA



By Hal Chamberlin

DEBUGGING AIDS

HAT DO you use your computer's front panel for? Loading programs into memory, monitoring their execution, altering their execution with the sense switches, single-stepping the program to find errors ("bugs"), changing memory locations, and troubleshooting hardware are some examples. Last month, the role of monitor programs such as Motorola's Mikbug in performing routine computer operation tasks was described here. It should have been apparent that the use of a monitor for such functions is far more convenient than using a traditional front panel. But what about nonroutine, troubleshooting tasks such as tracing the execution of a new, untried program or locating a hardware malfunction on a new board? Many hobbyists feel that a control panel is indispensable in such situations. Let us examine how monitor software can be used to perform even these "debugging" functions more effectively than a front panel.

Breakpoints. Assume that you have just finished writing a relatively complex program of 200 instructions in machine

language and are ready to test it. First you load it into memory, hopefully using a monitor and keyboard. After loading by hand, you save the program on tape just in case it wipes itself out in memory as errant programs often do. Then using the monitor's "G" command you execute the program. Chances are it does not execute properly. In fact, it's probably not even close. At this point debugging begins, which can take considerable time without good debugging tools.

If you have an Altair, Imsai or other front-panel oriented computer you will probably single-step your way through the program in an effort to find out where it goes awry. This means simply that the computer is placed in a single-step operating mode where every operation of the "single-step" switch causes exactly one machine cycle to be executed. Generally, as each cycle is executed, you can see in the console lights the memory or input/output address referenced by the cycle and the data transferred. Additional status lights identify the type of cycle out of about a half-dozen possibilities. However there are many things that the

panel lights fail to show. For example, when executing an "add register B to register A" instruction in single-step mode, you will only see the memory address of the instruction and the operation code, 200 in octal. You will not see the contents of register A, register B, or the result of the addition. Even the condition flags such as overflow are hidden from view. Obviously the panel is of limited value if you think the root of a particular bug lies in incorrect register contents or if there is an uncertainty as to what a specific instruction does. If this information is critical (as it often is), you must temporarily modify your program to store the necessary data into memory and then halt so that it may be examined.

Another often encountered difficulty is that single-stepping through a loop a dozen times to catch an error that occurs on the thirteenth iteration can take a long time. If the problem occurs on the 387th iteration it would not even be practical to single-step. Again the program must be temporarily modified to make it halt close to the error condition. Such temporary patches are called "breakpoints."

Many monitors have commands or functions that make inserting and keeping track of breakpoints much easier. A command like "3:213B" might insert a breakpoint at location 213 in page 3 (octal notation). What would actually happen is that the monitor would first look at the indicated address and save whatever was there. Next it would store a CALL instruction in the same location which would transfer control to a "breakpoint subroutine" in the monitor. This monitor

TEST OF DOUBLE PRECISION SUBTRACT

001:000 006 123	MVI B, 123Q	SET BC TO 123:156 = 21358 DECIMAL
001:002 016 156	MVI C, 156Q	**************************************
001:004 026 356	MVI D,356Q	SET DE TO 356:312 = -4405 DECIMAL
001:006 036 312	MVI E,312Q	
001:010 315 000 003	CALL DSUB	DO THE SUBTRACTION
001:013 311	RET	RETURN TO THE MONITOR

DOUBLE PRECISION SUBTRACT REGISTERS B AND C FROM D AND E WITH RESULT PLACED IN D AND E

DSUB			SUBTRACT LOWER BYTES
	MOV	E,A	MOVE RESULT INTO E
	SBB	A,D B	SUBTRACT UPPER BYTES
	MOV	D,A	MOVE RESULT INTO D
	DSUB	SUB MOV MOV SBB MOV	SUB C MOV E,A MOV A,D SBB B MOV D,A

Fig. 1. Program to be traced.

002:232 123 002:232 123		(Command to trace between 003:000 and 003:006 (Command to start execution at 001:000
003:001 221 003:002 137 003:003 172	A=130 E=130 A=356 A=203 FLG=SA	56 D=356 E=312 H=113 L=002 SP=017:374 FLG=
002:232 123	(next command)	Fig 9 Manitan maintant with turns

Fig. 2. Monitor printout with trace. Underlined portion typed by user.

routine prints the contents of all registers and the condition flags.

Now that the breakpoint is set up, the program would be entered with the normal "G" command. When it got to the "CALL BREAKPOINT" instruction that was inserted, the registers and flags would be printed. After the printout, the monitor would be waiting for another command. When the breakpoint is no longer needed, an "E" command might erase the breakpoint and restore the instruction it saved.

A more sophisticated monitor could allow multiple breakpoints. It would automatically keep track of the instruction displaced by each breakpoint and identify the breakpoint when the registers were printed. A really good breakpoint routine might even execute the saved instruction after printing and then automatically return to the program being debugged. In this case, a breakpoint could not be placed on top of a JUMP or CALL instruction.

A breakpoint routine can also take care of the "error on the 387th loop" problem mentioned earlier. Each time the breakpoint routine is entered, a software counter is decremented. If the counter is not zero, the user program is re-entered without printing the registers. Only when the counter finally does become zero do the registers get printed—thus saving a lot of time and paper. There would, of course, be a command to set the initial value of the counter.

Some microprocessors make the task of implementing a breakpoint facility in a monitor much easier. In the 8080 a normal CALL instruction is three bytes long. When placed in a breakpoint location, the three bytes that were there have to be saved. These three bytes might represent as many as three separate instructions making the "print registers and continue" function very difficult to implement. The 6800 or 6502, on the other hand, has a one-byte BREAK instruction that seems to be custom designed for just this function.

Software Single-Step. Although breakpoint capability in a monitor greatly simplifies the debugging of machine language programs, it is not real single-stepping. A different class of monitor routines called "trace routines" allows the software equivalent of single-stepping. It is interesting to note that some microprocessors are "dynamic" and cannot be stopped to allow the usual hardware single-step function. With these, a trace routine is the only way to get a single-step operation.

Tracing is really equivalent to putting a breakpoint at every instruction in a program. Then when the program is executed, a printout of the location, instruction, and all registers would be given for each instruction executed. This would be exactly equivalent to manual single-stepping with the bonus of a written record of every aspect of the program execution. In a machine with a lot of registers, time and paper may be saved by only printing the registers that have changed since the last printout. A useful trace feature in a monitor would allow the setting of trace limits so that only the program section of interest would be traced. A fancy trace feature might even allow multiple sets of trace limits with possibly a counter to delay the printing until a specified number of traced instructions has been executed.

How are trace routines actually implemented? One simple method is to use the interrupt feature of the microprocessor itself. With this method, a simple circuit added to the computer is activated to issue an interrupt whenever an instruction is executed. This interrupt would prohibit further interrupts and cause execution of the monitor trace print subroutine. The print routine would not re-enable interrupts until just before it returns to the interrupted program, the one being traced. This prevents the trace print routine from being traced itself. The trace limit feature is implemented by having the trace print routine check if the instruction about to be printed is within the trace limits. If it is not, printing is suppressed and a return to the program is executed. An example is shown in Figs. 1 and 2.

Another method involves interpreting the instructions of the traced program rather than executing them. An interpreter is a program that acts just like the microprocessor itself. It literally looks at the operation codes, addresses, and other components of the instruction and, through software, accomplishes the same result as the real microprocessor would have. The purpose of this is that the interpreter program may also store or print detailed information about the instructions it "executes", something the real microprocessor, of course, would not do. This technique requires much more complex software than breakpoints or trace using interrupts does but it has an important advantage. Since the interpreter routine simulates the machine, it can also simulate hardware features that the real machine may not have, such as memory protect. While debugging, the simulator would trap any instruction that attempts to jump outside of the protected area as well as any instruction that tries to write into protected memory.

Unfortunately the standard, readily available monitors in read-only memory generally do not have these debugging functions. If anything, a simple breakpoint facility is all that is offered. Specialized monitors, designed primarily for debugging rather than routine operations, on the other hand can probably do everything that has been discussed as well as other handy functions. These monitors are often found in the microprocessor manufacturer's development systems, such as Intel's MDS or Motorola's Exorciser (meaning to "exorcise" bugs) and are quite expensive. However the functions described are not difficult to implement and are certainly worth the effort needed to write them. Club meetings provide opportunities to exchange such software with fellow hobbyists. 0



By Ray Newhall, KWI6010

UNCLE CHARLIE IS SNOWED-IN

HEY tell us that even the ladies' room at Gettysberg is stacked high with mailbags. The FCC offices there process all Class D (now the "Citizens Band Radio Service") license applications and, between January 1st and 26th, had received more than 832,000 new CB license applications. However, reports are that their computer facility has been working so effectively that expected delays in processing those applications which were properly filed are only two to four weeks. To the FCC's delight, no more than 20% of applications received have included fees, which have to be returned since there is no longer a license charge.

Best estimates are that the FCC will issue more than 990,000 CB licenses in January. That represents an increase of more than 50% above the next greatest month (March 1976). The FCC believes that more than 8,000,000 new CB'ers will go on the air during 1977 and that the total number of licenses issued will exceed 16 million by the end of the year.

Total sales do not appear to account for the flood of license applications received. It appears that many would-be CB'ers are taking advantage of the fee amnesty and are being joined by many others who have been operating without a license. Also, different members of the same family are applying for their own licenses. FCC people tell me that, in many cases, a half dozen or so applications are arriving in the same envelope.

Why Were the Fees Dropped? As most of you know, the FCC handed CB'ers a nice Christmas present by suspending all fees, effective January 1st 1977. That sudden move was not entirely in the spirit of Christmas, however. It was prompted by a court decision ordering the FCC to suspend all fees until fee schedules are restructured, based upon the actual costs for issuance of licenses. In fact, they were ordered to refund all fees collected since January 1975, but don't hold your breath in anticipation; the

FCC's records on CB licensees do not go back that far in many cases. It is likely that fees will be reestablished again within a few months, and Congress might even pass legislation which permits the Commission to charge fees to help support the enforcement effort.

Some New Developments. When the fourth general meeting of PURAC was adjourned on January 27, it marked the halfway point in the advisory group's two-year Congressional charter. Earlier that morning the meeting was opened with an address by Al Gross, the first licensed CB'er (19W-0001). He recounted all the early efforts to get CB rolling, dating back to World War II. He showed us a pocket-sized walkie-talkie which had been used by the OSS during the war. It was this tiny radio transceiver that convinced the FCC and others that there was a viable future in personal radio communications.

Based on discussions at the meeting, quick FCC action is likely on a proposal by the public safety task group that the four callsign digits, "0911", be set aside for the exclusive use of state-level public service agencies as an emergency-aid callsign. These special calls, a "K" followed by the State's two-letter abbreviation and the four digits "0911," would be issued to any State applying for licensing under the National Emergency Radio Aid (NEAR) program. For example, in Connecticut the NEAR callsign to summon emergency road assistance on channel 9 would be KCT-0911.

The advisory committee was told that the FCC's Office of Plans and Policy would soon release a radio spectrum inventory report which would study areas of the spectrum for future expansion of Personal Radio Services, including:

•A new FM band somewhere between 218 and 225 MHz.

•Future allocation of a portion of the reserved spectrum near 900 MHz.

A new band of FM frequencies at about 220 MHz ("Class E") was first pro-

posed nearly ten years ago; it now appears that it will be considered anew, but prospects are dim for its adoption. In contrast, the possibility of using 900 MHz for distant CB expansion is viewed more optimistically by the FCC. In any event, the FCC pronounced that the recently expanded 27-MHz band "... won't be eliminated ... is here to stay."

Meanwhile, how many CB'ers have considered moving up to the old Class A band around 465 MHz (now redesignated the General Mobile Radio Service)? Here you can use up to 50 watts of power and antenna heights up to 200 feet. Repeaters and automatic phone patches are permitted. It offers nearly all the features now enjoyed by the hams on the 2-Meter band. However, the equipment is several times the cost of present CB equipment.

From the "Future Needs" Task Group, Cary Hershey, a sociologist at Columbia University, made an interesting observation. In response to a question from the floor regarding the damaging effect of Smokey reports by mobile CB units, he said:

"We have considered the 'Smokey Syndrome' in depth and weighed its negative effects against other factors relating to personal use radio. We have concluded that the sociological advantages to the American public in talking and listening, in direct communication with one another as opposed to all listening only to the media, far outweigh the opportunities offered a minority of criminals using CB to evade the law."

He continued by pointing out that the more inventive law-enforcement agencies have found that the so-called Smokey Syndrome can actually assist their enforcement efforts.

In the area of "Rules Compliance." the committees noted that rules infractions have dropped significantly. They rate the most serious violations as those involving the continued use of "linears" to exceed r-f power output limits and deliberate interference with communications. Though FCC members rate the non-use of callsigns high on their list of violations, the non-FCC members of PURAC tend to down-grade the seriousness of this violation and are examining alternate means of transmitter identification. The primary argument against the Automatic Transmitter Identification Signal (ATIS) involves the management of a data base of information on 30-million or more transmitters. This writer, who is also a data-processing consultant, believes that the FCC will eventually have

ORGANIZATION OF THE PERSONAL RADIO SERVICES, Part 95

Old Class New Designation Designation		Part 95 Sub-part	
Class A	General Mobile Radio Service	Α	
Class C	Radio Control (R/C) Service	C	
Class D	Citizens Band (CB) Radio Service	D	
_	All Technical Specifications	E	

to bite the bullet and spend the money to do the job properly. It is an expensive operation.

The FCC is determined to make it very risky to operate overpowered rigs. The reason it is so up-tight about external power amplifiers (linears) is because laboratories operating in both the government and private sectors have now determined that more than 60% of all CB-caused TVI results directly from the use of these illegal devices. This is particularly true with the "cheapie" import varieties that are being sold illegally in the United States. They cause all sorts of havoc on frequencies outside of the CB band, and are illegal to manufacture, sell, or even to own in this country. In spite of this, someone managed to slip a packet of sales material onto the FCC reception table at the PURAC meeting! TVI complaints, mostly CB-related, have increased more than ten-fold over the past two or three years.

It has now also been determined through extensive field tests that modern TV receivers are less susceptible than was originally thought to fundamental signals. Most TVI occurs under conditions of severe front-end overloading of the receiver, whether caused by an antenna preamplifier or by an extremely powerful CB signal. In a recent field test by the FCC's Field Operations Bureau, where 32 randomly selected CB-related TVI complaints were examined in depth, 63% were the direct result of external power amplifiers used to boost the CB signal well above the legal limit.

Rules Simplification. I have just completed a review of the reorganized version of Part 95, as reported earlier in this column, and I find it a great improvement over the older versions. These should be readily available through the GPO by the time this column is published. The three classes of personaluse radio services have been renamed under the overall designation of "Personal Radio Services" as shown in the Table listing. The 27 MHz CB service (Class D) has been designated the "Citi-

zens Band (CB) Radio Service." All of Part 95 required to be read and understood by a CB operator is contained in Sub-part D. This sub-part will be available as a separate publication.

The PURAC efforts to simplify Part 95 are still not complete. Work is already underway to simplify the language as well as the structure. It is expected that this work will be completed and available to the public by late summer 1977.

Legal Problems For CB'ers. As more and more CB'ers go on the air, their legal problems appear to be growing by leaps and bounds. Throughout the country, individual communities are attempting to outlaw CB by the use of local zoning or nuisance ordinances. In Connecticut, for example, there is a statute which was enacted long before CB was authorized making it illegal to operate a radiotelephone in a moving vehicle. Taxis, amateur radio operators, business radio users and commercial radiotelephone are exempted from the law, which appears to leave only CB'ers who can and have been arrested by the State Police. However, there are State Representatives who have pledged to work for the repeal of this law during the current legislative session.

But the number of legal actions which have reached the courts, involving either CB'ers or hams, has increased ten-fold within the past ten years, and a considerable amount of legal precedent is being accumulated. The *Personal Communications Foundation* is a new non-profit legal organization which was formed recently for the purpose of collecting and redistributing all the legal data available on such cases. Its services are free except for the actual cost of reproducing and mailing materials to those attorneys who request it in defense of a personal radio user. If you should have a legal problem, your lawyer may contact them in Lancaster, CA 93534 (805-942-0144).





RAS, our "seeing eye dog," gives drivers ample time to slow down before "the man" records his speed. This system, the most advanced detector

"Manufacturing Excellence Since 1919"

CIRCLE NO. 66 ON FREE INFORMATION CARD

on the market, is designed to minimize false signals.

Simply plug into lighter or wire direct. Select audio/visual or visual only with a flip of a switch.

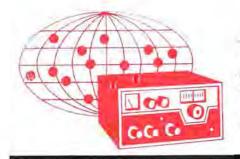
nly with a flip of a switch.

ENJOY TRAVEL MORE

AND WORRY LESS!
Retail \$109.95

\$89.95

ELECTRONICS UNLIMITED P.O. BOX 73 Lebanon, TN. 37087 (615) 449-1901



DX Listening

By Glenn Hauser

Secret Shortwave Stations. If you scan the non-broadcast bands with a good, sensitive receiver for evidence of broadcast programming, you should discover, as we did last fall, a number of tropical-band harmonics in the 18-25 MHz range. Some of them are listed below. As the sunspot count picks up, so should harmonic reception, even up to 31 MHz. Whether you hear the stations listed depends on skip conditions, but there is likely to be less interference on weekends. F₂ propagation peaks around noon, but sporadic E (short skip) can extend into the evening.

In regular out-of-broadcast-band tuning, you'll also find broadcast programs transmitted on SSB. Most feed the remote retransmission sites. Guyana Broadcasting Service is seldom armchair copy on 3.290 or 5.950 MHz, but when they activate 16.454 MHz, listening is easy. Radio Monte Carlo feeds Arabic programs of pop music to its MW relay on Cyprus, via 15.575 or 17.555 MHz frequently heard during the morning in North America. Chilean stations such as Radio Colo-Colo and Radio Cooperativa can be heard on 12.250, 6.6845 or 4.885 MHz at irregular hours.

MHz	Harmonic	Fundamental (MHz)	Station
24.3298	4	6.08245	R. Nacional, Peru
24.024	4	6.006	R. Reloj, Costa Rica
24.020	4	6.005	BBC, Ascension
23.850	2	11.925	Rdif. Portuguesa
23.630	2	11.815	BBC, Ascension
23.610	2	11.805	WYFR, Massachusetts
23.540	2	11.770	BBC, Ascension
19.860	4	4.965	R. Santa Fe, Colombia
19.480	2	9.740	Rdif. Portuguesa
19.328	4	4.832	R. Reloj, Costa Rica
19,210	2	9.605	Deutsche Welle, Antigua
19.100	2	9.550	R. Habana Cuba
19.050	2	9.525	R. Habana Cuba
18,5688	3	6.1896	La Voz de los Centauros, Colombia
18.3456	3	6.1152	La Voz del Llano, Colombia
18.315	3	6.105	La Pantera, Mexico
18.2262	3	6.0754	La Voz del Junco, Honduras
14.835	3	4.945	R. Colosal, Colombia
12.320	2	6.160	Em. Nueva Granada, Colombia

The World Station. Matching its image as the "number one" SW service in English, the BBC also publishes the best program guide, "London Calling." New subscribers to the illustrated free monthly had been turned down due to rising costs. But in April BBC began accepting subscriptions from anyone paying the new charge of \$10 per year (630 Fifth Ave., New York, NY 10020). Alternatively, you can consult our fortnightly column, Short Waves, in the Roundup section of the Sunday Denver Post.

A few late-April features we can tell you about here: Theatre of the Air, Sa-

turdays at 1830 GMT, Sundays at 0030 and 1130, presents Anouilh's "Antigone," Apr. 23/24. Radio Theatre, Sun. 1900, Thurs. 1345, Fri. 0030 has James Fairfax plays, "No Holds Barred," Apr. 17/21/22, and "Let's Play Politics," Apr. 24/28/29. Documentaries, Sun. 1709. Tues. 0030, Thurs. 1130 are "The Right Sort of Food," Apr. 17/19/21, and "The Changing Role of the Ambassador," Apr. 24/26/28. And Wed. 1430, Thurs. 0030, Fri. 2030, "One Hundred Years of Recorded Sound," Apr. 20/21/22, and "Shakespeare on Record." Apr. 27/28/29.

DX Programs. Radio Nederland is broadcasting a "Communications System Course" covering radio, TV, radar, navigation and radio astronomy, written by Jim Vastenhoud. Besides broadcasting each lesson two weeks in a row. printed lessons and illustrations are available free. You can still enroll in this course, which began April 7 on the Thursday "DX Juke Box" programs, and continues through the summer. R. Nederland is also celebrating 50 years of SWBC with a special QSL card, and yours truly is celebrating his 10th anniversary as a DX correspondent on the April 21 program. You can also hear our DX report in Spanish, the second Friday of each month on "Espacio DX-ista."

DX listeners are invited to participate in or monitor a ham net discussing all phases of DX'ing and SWL'ing, Wednesdays at 2130 GMT on 7.275 ±0.005 MHz (perhaps an hour earlier by GMT during daylight time). NCS is Charles, WB9NWF. Medium-wave DX'ers exchange tips Monday mornings at 0700 (0600 GMT, starting in May) on 3.900 MHz; listen for Skip, KOSBV, or Ross. W9BG.

The hams also operate a well-organized "intruder watch" designed to expunge non-ham stations from their bands, and qualified SWL's are invited to help. Contact the ARRL Intruder Watch, E. H. Conklin, K6KA, 402 Oliveta Pl., Box 1, La Cañada, CA 91011.

Mark Your Calendar. The International Committee of the Red Cross broadcasts only 4 hours a day, 3 days a week, 6 weeks a year, making its QSL more of a prize than others from Switzerland. Here's the schedule, via SBC on 7.210 MHz, for the rest of 1977: May 23/25/27; July 25/27/29: 26/28/30: Nov. 21/23/25. 0600-0700, 1130-1230, 1700-1800, 2200-2300 GMT. The last, and possibly the first, have a chance of being heard in North America this time of year. Mondays are in English; Wednesdays. French/German; and Fridays, Spanish/

If you make a point of listening to certain stations on important dates, you may hear extended or special programming. For a starter, try 5.047 MHz on April 27, Togo's National Day. Deutsche Welle is 24 years old on May 3. Liberation Day in Czechoslovakia is May 9, and R. Prague itself marks 54 years on May 18. Cameroun stations on 4.9725 and 5.010 MHz may observe National Day on May 20. Guyana Independence Day is May 26, a good time to check

16.454 MHz. May 31 is Republic Day in South Africa. Tunisia's National Day is June 1, and June 2 is Italy's Day of the Republic. Haiti's 4VEH celebrates 27 years on the air June 2-check 9.770 and 11.834 MHz. FEBC, Philippines is

29 on June 4, while Philippine Independence Day is June 12. Republic Day in Iceland, June 17, just might bring some special transmission on 12.175 MHz. (Dates were compiled by Cees van der Zalm for the Benelux DX Club.)

MAY-AUGUST ENGLISH-LANGUAGE SW B'CASTS by Richard E. Wood

		TO EASTERN NORT	H AMERIC	A
TIME-EDT	TIME-GMT	STATION	QUAL*	FREQUENCIES, MHz
6:28 a.m8:00 p.m.	1028-2400	**Montreel, Canada (Northern Service)	G	9.625, 11.72 (includes French, etc.)
7:00-7:25 a.m.	1100-1125	Tirana, Albania	F	9.50, 11.865
7:00-9:00 a.m.	1100-1330	Melbourne, Australia	G	9.58
7:00-9:30 a.m.	1100-1330	London, England	G	5.99 (via Sackville), 6.195 (via Antiqua), 11.79 (via Antiqua, tentative by midsummer) 15.07
7:00-10:00 a.m.	1100-1400	**VOA, Washington, USA	G	5.955, 9.73
7:05-8:25 a.m.	1105-1225	Trans-World Radio, Bonaire, N.A.	G	11.815
7:45-8:05 a.m.	1145-1205	**Montreal, Canada	G	9.56, 11.72
8:00-8:30 a.m.	1200-1230	Jerusalem, Israel	G	11.655, 15.10, 15.485, 17.685
8:00-8:55 a.m.	1200-1255	Peking, China	F	11.685
8:10-8:30 a.m.	1210-1230	**Santiago, Chile	F	9.566, 11.81, 15.15
8:15-8:30 a.m.	1215-1230	Athens, Greece	F	15.345, 17.83
		HCJB, Quito, Ecuador	G	11.745
8:30-9:00 a.m.	1230-1300	Stockholm, Sweden	G	15.305
8:30-10:00 a,m.	1230-1400	Trans-World Radio, Bonaire, N.A.	G	15.255 (Sat., Sun.)
8:30-11:30 a.m.	1230-1630	HCJB, Quito, Ecuador	G	11.745, 15.115
9:15-9:45 a.m.	1315-1345	Berne, Switzerland	G	15.14
9:30-10:00 a.m.	1330-1400	Helsinki, Finland	G	15.11
9:30-11:00 a.m.	1330-1500	**London, England	G	15.07
10:00-10:15 a.m.	1400-1415	**Montreal, Canada	G	15.325, 17.74
10:00-10:30 a.m.	1400-1430	Oslo, Norway	G	15.175 (Sun.)
		Stockholm, Sweden	G	15.305
10:30-11:00 a.m.	1430-1500	Helsinki, Finland	G	15.11
11:00 a.m12 noon	1500-1600	London, England	G	17.84 (via Ascension), 9.58 (via
				Sackville Sat., Sun.)
11:15-11:30 a.m.	1515-1530	Athens, Greece	P	11.73, 15.345, 17.83
12 noon-12:15 p.m.	1600-1615	London, England	G	9.58 (via Sackville)
10.00 10.00	4000 4000	0.1.		17.84 (via Ascension)
12:00 noon-12:30 p.m.		Oslo, Norway	G	15.175 (Sun.)
12:04-12:56 p.m.	1604-1656	**Paris, France	G	15.20, 15.30, 15.425, 17.72,
10.15 0.00	1015 1000	1 de-1 Pland		17.80, 17.82, 21.62
12:15-2:30 p.m.	1615-1830	London, England	G F	9.58 (via Sackville), 15.07
1:00-4:00 p;m.	1700-2000 1800-1830	**Kuwait, Kuwait	G	9.555, 9.58, 11.845
2:00-2:30 p.m.	1000-1030	**Montreal, Canada **Kampala, Uganda	F	11.855, 15.325, 17.82 15.325 (Tues., Thur., Set., Sun.)
2:30-3:00 p.m.	1830-1900	**Montreal, Canada	G	11.855, 15.325, 17.82
2:50-4:00 p.m.	1850-2000	**Abidian, Ivory Coast	G	11.92 (Sun.)
3:00-3:30 p.m.	1900-1930	**Montreal, Canada	G	11.855, 15.325, 17.82
3:00-4:00 p.m.	1900-2000	**Algiers, Algeria	F	11.91, 15.42 (variable)
3:00·6:00 p.m.	1900-2200	**Jeddah, Saudi Arabia	F	11.855
3:30-4:00 p.m.	1930-2000	**Montreal, Canada	G	11.855, 15.42, 17.82
4:00-4:30 p.m.	2000-2030	**Montreal, Canada	G	15.29, 15.325, 17.82
		**Tehran, Iran	F	9.022, (11.77 alternate)
		Jerusalem, Israel	G	9.009, 9.425, 9.815, 11.655, 15.10
4:00-5:00 p.m.	2000-2100	Accra, Ghana	F	11.85 (irregular)
4:00-5:20 p.m.	2000-2120	**Hilversum, Holland	G	11.73 (via Talata)
4:50-5:50 p.m.		**Havana, Cuba	G	11.865, 17.75
5:00-5:30 p.m.	2100-2130	**Brazzaville, Congo	G	15.19
5:00-5:50 p.m.	2100-2150	**Johannesburg, S. Africa	F	5.98, 9.585
5:00-6:00 p.m.	2100-2200	**Brasilia, Brazil	G	15.24 (11.78, 15.245 alternate)
5:15-6:45 p.m.	2115-2245	London, England	G	9.58, 11.75
5:30-6:50 p.m.	2130-2250	Hilversum, Holland	G	9.715, 11.73 (exc. Sun.)
6:00-6:15 p.m.	2200-2215	**Belgrade, Yugoslavia	F	6.10, 7.24, 9.62
6:00-6:30 p.m.	2200-2230	**Montreal, Canada	G	11.855, 15.325
		Oslo, Nurway	F	15.175 (Şun.)
		**Caracas, Venezuela	F	15.40 (varies, MonFri.)
6:00-7:15 p.m.	2200-2315	**Ceiro, Egypt	G	9.805
6:00-8:30 p.m.	2200-0030	Ankara, Turkey	G	9.515, 11.88
6:30-7:00 p.m.	2230-2300	Jerusalem, Israel	G	9.435, 9.815, 11.655, 15.10, 15.485
		Moscow, U.S.S.R.	G	7,105, 7,15, 7,355, 7,40, 9,655, 9,685
0.00 7.00 -	2220 2220	Johannesburg, S. Africa	F	11.735, 11.75, 11.87, 12.05 5.98, 9.585, 11.90
6:30-7:20 p.m.	2230-2320 2245-2300	London, England	G	5.975, 7.325, 9.58, 11.75
6:45-7:00 p.m.	2270 2000	mo-weddishing based		

CATCH-A-PULSE II® **LOGIC PROBE** TOMARINA

3.5 to 15V LEVELS ONLY \$39.95

10 Nsec SPEED AT

Compatible with RTL, DTL, TTL, CMDS, MOS, and Microprocessors using a 3.5 to 15V power supply. Thresholds automatically programmed. Automatic resetting memory. No adjustment required. Visual indication of logic levels, using LEDs to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt-pocket portable (protective tip cap and removable coil cord). Eliminates need for heavy test equipment. A definite savings in time and money for engineer and technician.

• 10 Nsec pulse response

- · Open circuit detection
- Multi-family
- Replaceable tip & cord
- · High input impedance
- Pulse stretching

Send \$39.95 (Calif. residents add 6% sales tax) to:



Box 26205, San Diego, CA 92126, [714] 566-1570

CIRCLE NO. 2 ON FREE INFORMATION CARD





The "XR-700" is a COMPLETELY NEW Ignition System that replaces the inefficient Breaker-Points and Condensor with a highly RELIABLE, Invisible "Infra-red" Light-Beam which CONTROLS the Latest design Solid-State POWER MODULE. This new "Patented" Invention produces the HIGHEST ENERGY, Longest Ouration Spark of ANY Ignition System manufactured TOOAY!

CUSTOMERS REPORT: "THE XR-700 MORE THAN PAYS FOR ITSELF ...and KEEPS ON SAVING MONEY with...

- ★ INCREASED "GAS-MILEAGE" up to 30%!
- ELIMINATING COSTLY "TUNE-UPS!" IMPROVED ENGINE PERFORMANCE!
- QUICKER STARTING IN ANY WEATHER! FASTER ACCELERATION...SMOOTHER RUNNING!

* THE XR-700 has NO moving parts to wear out...never needs adjustment! Engineered to O UTLAST Your Car...So RELIABLE... So PERFECTEO...that we give you a LIFETIME WARRANTY... "FREE Repair or Replacement" for as long as you OWN the Unit. even if you change Cars, we will supply the necessary Parts FREE.

FITS ALL ENGINES...Domestic or Foreign...4, 6 or 8-Cylinder
EASY INSTALLATION...Completely Factory ASSEMBLED!

Thousands sold at \$59.95 1 195 * NOW...ONLY... (Cal, Res. add Tax) THAT'S EVERYTHING.. INCLUDING POSTAGE & INSURANCE

* SAVE! ORDER FACTORY DIRECT!
Send Check or M/O, State Car Make, Year and No. of Cylinders.

MASTERCHARGE or BANKAMERICARO Cardholders Order by TOLL FREE PHONE (800) 423-6525 Ext. 3

> CALL or WRITE for FREE BROCHURE * America's Oldest and Largest Manufacturer

ALLISON AUTOMOTIVE CO.

of Opto-Electronic Ignition Systems. ©

1267 - PO, East EDNA PL., COVINA, CAL. 91722 CIRCLE NO. 7 ON FREE INFORMATION CARD





: 0804J/ - 178				
6:50-7:10 p.m.	2250-2310	**Santiago, Chile	F	9.56, 11.61, 15.15
7:00-7:30 p.m.	2300-2330	Stockholm, Sweden Moscow, U.S.S.R.	G	6.12, 9.695, 11.705 7.105, 7.15, 7.355, 7.40, 9.685, 11.735,
	. "			11,75, 11.87, 12.05,
	-	Vilnius, U.S.S.R.	G	9.655, 9.72, 9.745, 11.77 11.90 (Sat., Sun)
7:00-7:50 p.m.	2300-2350	**Buenos Aires, Argentina	G	11.71 (MonFri.)
7:30-8:00 p.m.	2330-2400	Helsinki, Finland	P	11.755
		**Radio Clarin, S. Domingo, Dom. Rep.	G	11.70 (irregular)
		London, England	G	5.975, 6.12 (via Antigua, tent.
7.90.0.90	2330-0030	Moscow, U.S.S.R.	G	by midsummer) 7.325, 9.58 7.105, 7.355, 7.46, 9.655, 9.685, 9.72,
7:30-8:30 p.m.	2330-0030	Moscow, O.S.S.H.	u	9.745, 11.735, 11.75, 11.77, 1187,
				11.90, 12.05
7:45-8:45 p.m, 8:00-8:25 p.m.	2345-0045 0000-0025	Tokyo, Japan Tirana, Albania	F G	15.27, 15.30 7.065, 9.75 (varies)
8:00-8:30 p.m.	0000-0030	Osla, Norway	F	9.645, 11.86 (Sun.)
8:00-8:55 p.m.	0000-0055	Sofia, Bulgaria	G F	9.70 (alternate 9.705)
8:00-9:00 p.m.	0000-0100	Peking, China **VDA, Washington, USA	G	11.675, 11.945, 15.06 6.19, 9.67, 11.83, 11.895
8:00-10:45 p.m.	0000-0245	**Luxemburg	F	6.09
8:00 p.m1:06 a.m.	0000-0506	**Montreal, Canada (Northern Service)	F	6.065, 9.625
8:15-8:30 p.m.	0015-0030	Brussels, Belgium	G	9.725
8:30-8:55 p.m.	0030-0055	Prague, Czechoslovakia	F	6.055, 9.74
8:30-9:00 p.m.	0030-0100	Stockholm, Sweden Kiev, U.S.S.R.	F G	11.955 9.60, 9.61, 11.69, 11.735, 12.05
8:30-9:30 p.m.	0030-0130	Moscow, U.S.S.R.	G	7.15, 9.53, 9.655, 9.685
		**Trans-World Radio,	G	11.925
8:30-11:30 p.m.	0030-0330	Bonaire, N.A. London, England	G	5.975, 6.12 (via Antigua, tent. by
		ASSESSED AND A		midsummer) 7.325, 9.51, (via
9:40 41:00 a m	0040-0300	HCJB, Quito, Equador	G	Greenville), 9.58 (via Ascension) 9.56, 11.915
8:40-11:00 p.m. 9:00-9:15 p.m.	0100-0115	Vatican, City	G	5.995, 9.605, 11.70
9:00-9:20 p.m.	0100-0120	Rome, Italy	G	9.575, 11.91
9:00:9:30 p.m.	0100-0130	Vilnius, U.S.S.R. Montreal, Canada	G	7.15, 7.215, 9.61, 11.69, (Sat., Sun.) 9.535
9:00-9:45 p.m.	0100-0145	Berlin, Ger. Dem. Rep.	P	9.73
9:00-9:55 p.m.	0100-0155	Peking, China	G	7.12, 9.78 (via Tirana), 9.94, 11.945,
		Prague, Czechoslovakia	G	15.06 5.93, 7.345, 9.54, 9.63, 9.74, 11.99
9:00-11:00 p.m.	0100-0300	Melbourne, Australia	G	15.32, 17.795
9:00-11:30 p.m. 9:00 p.m12 mdt.	0100-0330 0100-0400	Havana, Cuba Medrid, Spain	G	11.725, 11.93 6,08, (alternate 6,065)
3.40 p.m12 mac.	0100-0400	mounte, openi	u	11.88 (exp. Sun)
9:10-9:30 p.m.	0110-0130	**Santingo, Chile	F	9.566, 11.81, 15.15
9:30-9:50 p.m.	0130-0150	Cologne, Ger. Fed. Rep.	G	6.01, 6.04 (via Antiqua), 6.075, 9.565, 9.605
9:30-9:55 p.m.	0130-0155	Tirana, Albania	G	6 20 7 30
9:30-10:25 p.m.	0130-0225	Vienna, Austria Bucharest, Rumania	P	6.155, 9.77 5.99, 9.57, 9.68, 11,775, 11,94
9:30-10:30 p.m.	0130-0223	Moscow, U.S.S.R.	G	7.15, 7.215, 9.53, 9.685,
	0445 0045			9.70 (via Sofia)
9:45-10:15 p.m. 10:00-10:30 p.m.	0145-0215 0200-0230	Berne, Switzerland Budapest, Hungary	G	5.965, 6.135, 9.725, 11.715 6.00, 7.215, 9.585, 9.833, 11.91
		*		(Exc. Sun.)
		Oslo, Norway	F	9.645, 11.86, 15.175 (Sun.) 6.085, 9.535
		Montreal, Canada Warsaw, Poland	G P	6.095, 6.135, 7.27, 9.675,
10-00 10-55	0000 0055	Date: Ob.	_	11.815, 11.84, 15.12
10:00-10:55 p.m. 10:00-11:20 p.m.	0200-0255 0200-0320	Peking, China Hilversum, Holland	F G	9.94, 12.01, 12.055 6.165 (via Bonaire)
10:00-11:30 p.m.	0200-0330	Cairo, Egypt	G	9.475
10:10-10:30 p.m. 10:15-10:30 p.m.	0210-0230 0215-0230	**Santiego, Chile	F	9.566, 11,81, 15,15
10:30-10:55 p.m.	0230-0255	Athens, Greece Tirana, Albania	G	9.75, 9.76, 11.73 6.20, 7.30
10:30-11:00 p.m.	0230-0300	Stockholm, Sweden	F	9.695, 11.705
		Moscow, U.S.S.R.	G	7.39, 9.50, 9.53, 9.61, 9.685, 9.70 (via Sofia)
10:30-11:15 p.m.	0230-0315	Berlin, Ger. Dem. Rep.	Р	9.73
11:00-11:30 p.m.	0300-0330	Budapest, Hungary	F	6.00, 7.215, 9.585, 9.833, 11.91
		Kiev. U.S.S.R.	G	(Tues., Fri.) 7.39, 9.61
		Lisbon, Portugal	F	6.025, 11.935
11:00-11:35 p.m.	0300-0335	Moscow, U.S.S.R. Warsew, Poland	G	9.50, 9.685, 9.70 (via Sofie) 6.095, 6.135, 7,27, 9.675,
				11.815, 11.84, 15.12
11:00:11:55 p.m. 11:00 p.m12 mdt	0300-0355 0300-0400	Peking, China Buenos Aires, Argentina	G	7.12, 9.78 (via Tirana)
. Leve brite 15 min('	0000-0400	Prague, Czechoslovakia	G	9.69 (MonFri.) 5.93, 7.345, 9.54, 9.63, 9.74, 11.99
11:00-12:25 a.m.	0300-0425	**Johannesburg, S. Africa	F	5 98, 7.27
11:00 p.m1:00 a.m. 11:10-11:30 p.m.	0300-0500 0310-0330	HCJB, Quito, Ecuador **Santiago, Chile	G F	6.095, 9.56, 11.915 9.566, 11.81, 15.15
		2		

Department 217S 12 East Delaware Chicago, Illinois 60611 312-664-0020

IUON

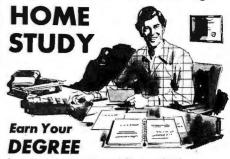
11:30-11:55 p.m. 0330-0355	Tirana, Albania	G.	6.20, 7.30
387 . 331	Vienna, Austria	P	6.155, 9.77
1:30 p.m12 mdt, 0330-0400	Moscow, U.S.S.R.	G	7.39, 9.50, 9.61, 9.685, 9.70 (via Sofia)
1:30 p.m12:30 a.m. 0330-0430	London, England	G	5.975, 6.12 (via Antiqua, tent. midsummer)
1:30 p.m12:50 a.m. 0330-0450	Havana, Cuba	G	11.725, 11.76, 11.93
12:00 mdt12:15 a.m. 0400-0415	Budapest, Hungary	G	6.00, 7.215, 9.585, 9.833, 11.91
			(Tues., Fri.)
12:90 mdt12:25 a.m. 0400-0425	Bucherest, Rumania	F	5.99, 6.155, 6.19, 9.57, 9.68, 11.775, 11.94
2:00 mdt12:30 a.m. 0400-0430	Oslo, Norway	F	9.645, 11.86 (Sun.)
12:30-1:00 a,m. 0430-0500	London, England	G	6.175 (via Antiqua)
12:50 p.m2:00 a.m. 0450-0600	Havana, Cuba	G	11.725, 11.93
1:00-1:15 a.m. 0500-0515	Jerusalem, Israel	G	7.412, 9.815, 11.655
1:00-1:30 a.m. 0500-0530	Lisbon, Portugal	G	6.025, 11,935
1:00-3:00 a.m. 0500-0700	HCJB, Quito, Ecuador	G	6.095, 9.56
1:00-3:30 a.m. 0500-0730	London, England	G	6.175, (via Antigua)
4			9.51 (via Antigua, tent. by midsummer)

		TO WESTERN NORT	H AMERI	CA
TIME-PDT	TIME-GMT	STATION	QUAL*	FREQUENCIES, MHz
A.00 A.15	1100 1115			r.00
4:00-4:15 a.m. 4:00-5:25 a.m.	1100-1115	Tokyo, Japan Trans-World Radio,	P	5.99 11.815
1.00 0.20 2,00.	1100 1220	Bonaire, N.A.	٠	11,013
4:00-6:30 a.m.	1100-1330	London, England	G	5.99 (via Sackville), 6.196 (via Antigua), 11.75 (via Tebrau), 11.79 (via Antigua
				tent. midsummer)
4:00-7:00 a.m.	1100-1400	**VOA, Washington, USA **4VEH, Cap-Haitien,	G G	5.955, 9.73 9.77, 11.835
5:00-5:15 a.m.	1200-1215	Haiti Tokyo, Japan	P	5.99
5:00-5:30 a.m.	1200-1210	**Tashkent, U.S.S.R.	G	9.60, 11.925
5:10-5:30 a.m.	1210-1230	**Santiago, Chile	F	6.195, 9.566, 11.81, 15.15
5:16-5:30 a.m.	1215-1230	HCJB, Quito, Ecuador	G	11,745
5:30-7:00 a.m.	1230-1400	Trans-World Radio	G	15.255 (Sat., Sun.)
, 5155 7 155 51(1)		Bonaire, N.A.		141-7-14-14
5:30-9:30 a.m.	1230-1630	HCJB, Quito, Ecuador	G	11.745, 15.115
6:00-6:15 a.m.	1300-1315	Tokyo, Japan	Р	5.99
6:30-6:50 a.m.	1330-1350	**Santiago, Chile	F	6.195, 9.566, 11.81, 15.15
6:30-8:00 a.m.	1330-1500	**Delhi, India	F	11.81
7:00-7:30 a.m.	1400-1430	Tokyo, Japan	G	9,505
		**Tashkent, U.S.S.R.	G	9.60, 11.925
7:00-8:20 a.m.	1400-1520	**Hilversum, Holland	G	11.73 (via Talata)
7:00-9:55 a.m.	1400-1655	Manile, Philippines (VOP)	F	9.58 (Closes 1555 Sun.)
8:00-8:15 a,m.	1500-1515	Tokyo, Japan	G	9.505
8:00-9:00 a.m.	1500-1600	London, England	G	17.84 (via Ascension)
				also 9.58 (via Sackville Sat., Sun.)
9:00-9:15 a.m.	1600-1615	Tokyo, Japan	G	9.505
A could be a consider a		London, England	G	9.58, 15.365 (via Sackville), 17.84 (via Ascension)
9:04-9:56 a.m.	1604-1656	**Paris, France	G	15.20, 15.30, 15.425, 17.72, 17.80, 17.82, 21.62
9:15-10.09 a.m.	1615-1809	London, England	G	9.58, 15.365 (via Sackville)
9:42-9:51 a.m.	1642-1651	Hilversum, Holland	G	15.19, 17.775 (MonFri.)
10:00-10:15 a.m.	1700-1715	Tokyo, Japan	G	9.505
10:00 a.m1:00 p.m.	1700-2000	**Kuwait, Kuwait	°F	9.555, 9.58, 11.845
10:09-11:00 a.m.	1709-1800	London, England	G	9.58, (via Sackville)
11:00-11:09 a.m.	1800-1809	London, England	G	9.58 (via Sackville),
				11.815 (via Ascension)
11:00-11:15 a.m.	1800-1815	Tokyo, Japan	G	15,105
11:00-11:30	1800-1830	**Kampala, Uganda	F	15.325, (Tues., Thur., Sat., Sun.)
		Oslo, Norway	F	11.895 (Sun.)
11:45 a.m. 1:00 p.m.	1845-2000	**Abidjan, Ivory Coast	G	11.92 (Sun.)
12 noon-12:15 p.m.	1900-1910	**Papeete, Tahiti	F	11,825, 15.17 (exc. Sun.)
12:00-12:15 p.m.	1900-1915	Tokyo, Japan	G	15.105
1:00-1:15 p.m.	2000-2015	Tokyo, Japan	G	15.105
1:00-2:20 p.m.	2000-2120	Hilversum, Holland	G	11.73 (via Talata)
1:30-1:50 p.m.	2030-2050	**Santiago, Chile	F	9.566, 11.81, 15.15
1:30-2:00 p.m.	2030-2100	**Kempala, Uganda	F	9,73 (Sat., Mon. Wed., Fri.)
2:00-2:15 p.m.	2100-2115	Tokyo, Japan	G	16.105
2:00-2:30 p.m.	2100-2130	**Brazzaville, Congo	G	15.19
2:00-3:00 p.m.	2100-2200	**Brazilia, Brazil	G	15.24 (alternates 11.78, 15.245)
2:30-3:30 p.m.	2130-2230	**Taipei, Taiwan	F	15.225
3:00-3:15 p.m.	2200-2215	Tokyo, Japan	G	15.105
3:00-3:30 p.m.	2200-2230	**Caracas, Venezuela	F	15.40 (varies; MonFri.)
3:00:5:00 p.m.	2200-2400	**VOA, Washington, USA	G.	17.82, 17.895, 21.61
H. J. M TVASCA	3	Montreal, Canada	A F	3.30 (month int)
3:30-4:00 p.m.	2230-2300	Jerusalem, Israel	G	9,435, 9,815, 11,655, 15,10, 18,485
3:30-4:20 p.m.	2230-2320	Johannesburg, S. Africa	F	5.98, 9.585, 11.90
3:30-5:30 p.m.	2230-0030	Moscow, U.S.S.R.	G	9.635, 9.78, 12.05, 15.14, 15.18, 15.455, 17.72
3:50-4:10 p.m.	2250-2310	**Santiago, Chile	F	9.566, 11.81, 15.15
4:00-4:30 p.m.	2300-2330	Tokyo, Japan	G	15:105 11:535, 15:63
4:00-5:00 p.m	2300-2400	**Pyongyang, Dem. Rep. Korea	_ r	(variable)
.91	1	ush: Votes		(Applicate) :

Put Professional Knowledge and a

COLLEGE DEGREE

in your Electronics Career through



by correspondence, while continuing your present job. No commuting to class. Study at your own pace. Learn from complete and explicit lesson materials, with additional assistance from our home-study instructors. Advance as fast as you wish, but take all the time you need to master each topic. Profit from, and enjoy, the advantages of directed but self-paced home study.

The Grantham electronics degree program begins with basics, leads first to the A.S.E.T. degree, and then to the B.S.E.E. degree. Our *free* bulletin gives complete details of the program itself, the degrees awarded, the requirements for each degree, and how to enroll. Write for *Bulletin E-77*.

Grantham College of Engineering

2000 Stoner Avenue P. O. Box 25992

Los Angeles, CA 90025

Worldwide Career Training thru Home Study
CIRCLE NO. 27 ON FREE INFORMATION CARD

<u>COMPUTER MUSIC?</u>



OUR EQUALLY TEMPERED D/A CONVERTER MAKES IT EASY!

- : 5+ octaves of control voltage from 6 bits of data.
- ; hand-shaking logic.
- : use with any processor.
- : drives even the simplest linear oscillators & fitters.

8780 D/A CONVERTER KIT.....\$34.95

(plus \$1.00 postage for mail orders)

8782 ENCODED KEYBOARD \$109.95...wt. 2016s. COMPLETE SYNTHESIZER PACKAGES AS LOW AS \$239 Modules; YCO's, YCF's, Noise Sources, & More * keyboards shipped freight collect

__DETAILS IN OUR FREE CATALOG



DEPT 5-P 1020 W. WILSHIRE BLVD. OKLAHOMA CITY, OK 73116

HEAR-IT-YOURSELF



This is a Speakerlab 7, a 4element acoustic suspension speaker kit you can assemble yourself in an hour with simple tools.

It saves you up to 50% over comparable ready made systems. Read about the \$7 and other systems and raw speakers we sell in a new 40 page catalog. It's a factpacked manual with chapters on acoustic theory, enclosures, choosing drivers and design principles.

And it's free. Just write us and ask for the most complete catalog/manual ever written on speaker building.





Our whole family helped assemble this wonderful Schober Organ... and now we all play it!

Talk about real tamily fun! We all worked together, for a few hours almost every day. Almost too soon, our Schober Organ was finished. Our keen-eyed daughter sorted resistors. Mom soldered transistor sockets, although she'd never soldered anything before. And it did our hearts good to see the care with which our son—he's only 12—installed the transistors. Me? I was the quality control inspector—they let me do the final wiring. Our completed Schober Organ compares favorably with a "ready-made" one costing twice as much! (The five models range from \$650 to \$2850.)

Just send the coupon for the fascinating Schober color catalog (or enclose \$1 for a 12-inch LPrecord that lets you hear as well as see Schober quality).

The Schoker Organ Corp., Dept. PE	-71
43 West 61st Street, New York, N.Y. 1002:	3

ADDRESS

STATE

	West 61st Street, New York, N.Y. 10023
	Please send me Schober Organ Catalog. Enclosed please find \$1.00 for 12-inch L.P. ecord of Schober Organ music.
NΙΑ	VE

4:00-4:30 p.m.	2300-2330	London, England	G	6.175, 9.51 (via Sackvijle)
4:30-5:00 p.m.	2330-2400	**Radio Clarin,		9.58 (via Ascension)
4:30-5:30 p.m.	2330-0030	S. Domingo, Dom. Rep. London, England	G G	11.70 (irregular MonFri.) 6.12 (via Antigua tent, by
		L. M. C.		midsummer) 6.175, 9.51 (via Sackville)
5:00-5:15 p.m.	0000-0015	Tokyo, Japan	G	15.105
5:00-6:00 p.m.	0000-0100	**VOA, Washington, USA	G	11.83, 11.895, 15.40
5:30-6:00 p.m.	0030-0100	Moscow, U.S.S.R.	G	9.635, 9.78, 12.05, 15.14, 15.18, 15.455, 17.72
5:30-6:30 p.m.	0030-0130	**Trans-World Radio, Bonaire, N.A.	G	11.925
5:30-8:30 p.m.	0030-0330	London, England	G	6.12 (via Antigua, tent. by midsummer) 6.175 (via Sackville),
				9.51 (via Greenville),
E.40 D.00	0040-0300	UCID Ouite Faunder	G	9.58 (via Ascension)
5:40-8:00 p.m.		HCJB, Quito, Ecuador	G	9.56, 11.915
6:00-6:15 p.m.	0100-0115	Tokyo, Japan	G	15.105
6:00-6:30 p.m.	0100-0130	Moscow, U.S.S.R.		9.635, 9.78, 12.05, 15.14, 5 15.18, 15.455
6:00-7:00 p.m,	0100-0200	Taipei, Taiwan	F	15.425, 17.89
6:00-8:00 p.m.	0100-0300	Melbourne, Australia	G	15.32, 17.796
6:00-9:00 p.m.	0100-0400	Madrid, Spain	F	6.08, (alternate 6.065), 11.88
6:10-6:30 p.m.	0110-0130	**Santiago, Chile	F	6.195, 9.566, 11.81, 15.15
7:00-7:30 p.m.	0200-0230	Moscow, U.S.S.R.	G	9.635, 9.78, 11.86, 12.05, 15.14
7:30-8:00 p.m.	0230-0300	Stockholm, Swaden	F	9.695, 11.705
		Moscow, U.S.S.R.	G	9.635, 9.78, 11.86, 15.14
8:00-8:15 p.m.	0300-0315	Tokyo, Japan	G	15.105
8:00-8:30 p.m.	0300-0330	Kiev, U.Ş.S.R.	G	9.58, 9.635, 9.78, 11.86
	00,000	Seoul, Rep. Korea	F	11.86
		Moscow, U.S.S.R.	G	9.655, 12.05
8:00-8:55 p.m.	0300-0355	Peking, China	G	7.12, 9.78 (via Tirana), 11.445, 12.055,
		, oams, om		15.06, 15.385, 17.735, 17.855
8:00-9:20 p.m.	0300-0420	**Johannesburg, S. Africa	F	5.98, 7.27
8:00-10:00 p.m.	0300-0500	HCJB, Quito, Ecuador	G	6.095, 9.56, 11.915
8:10-8:30 p.m.	0310-0330	**Santiago, Chile	F	6.195, 9.56, 11.81, 15.15
8:20-9:25 p.m.	0320-0425	**TIFC, San Jose, Costa	F	6.035, 9.645, (opens 0300 Set., Sun.)
0.20 0.20 p.m.	0020-0423	Rica		0.000, 5.040, topolis odou batt, built,
8:22-8:28 p.m.	0322-0328	Erevan, U.S.S.R.	G	9.54, 9.735, 11.69, 15.14
0.22 0.20 p.m.	0022 0020	Crovati, D.D.D.TI.	ü	(Sat./Tue./Wed./Fri.)
8:30-9:00 p.m.	0330-0400	Moscow, U.S.S.R.	G	9.54, 9.58, 9.635, 9.735, 9.78, 11.69, 15.14, 11.87, 12.00, 12.05,
				15.10, 15.21
8:30-9:15 p.m.	0330-0415	Berlin, Ger. Dem. Rep.	F	11.89, 12.00
8:30-9:30 p.m.	0330-0430	London, England	G	6.12 (via Antiqua tent. midsummer). 6.175 (via Sackville)
9:00-9:15 p.m.	0400-0415	Tokyo, Japan	G	15.105
9:00-9:30 p.m.	0400-0430	Dslo, Norway	F	6.18, 9.55, 9.645
		Budapest, Hungary	F	6.00, 7.215, 9.585, 9.833, 11.91
				(Tue., Fri.)
0.00 12.20	0400 0720	Montreal, Canada	G	9.655, 11.765
9:00 p.m12:30 a.m.	0400-0730	Moscow, U.S.S.R.	G	9.54, 9.58, 9.635, 9.71, 9.78, 11.69, 11.87, 12.00, 12.05, 15.10, 15.21
9:30-10:00 p.m.	0430-0500	Berne, Switzerland	G	9.726, 11.745
	111	Sofia, Bulgaria	F	9.70 (alternate 9.705)
9:30-12:30 a,m.	0430-0730	London, England	G	6.175 (via Antiqua)
10:00-10:15 p.m.	0500-0515	Jerusalem, Israel	F	7.412, 9.815, 11.655
		Tokyo, Japan	G	15,105
10:00-10:30 p.m.	0500-0530	Lisbon, Portugal	F	6.025, 11.935 (varies)
10:00-11.20 p.m.	0500-0620	Hilversum, Holland	G	6.165, 9.715, (via Bonaîre)
10:00-12 mdt.	0500-0700	HCJB, Quito, Ecuador	G	6.095, 9.56
10:00 p.m12:30 a.m.	0500-0730	London, England	G	6.175 (via Antiqua)
				9.51 (via Antiqua tent. by midsummer)
10:30-10:50 p.m.	0530-0550	Cologne, Ger. Fed. Rep.	G	5.96 (via Antiqua) 6.10 (via Malta), 6.185, 9.545
11:00-11:15 p.m.	0600-0615	Tokyo, Japan	G	9.505
11:00-11:30 p.m.	0600-0630	Oslo, Norway	P	
Troop park	חניווים. מממי	Seoul, Korea	F	6.18, 9.645 (Sun.) 9.73
11:00 p.m12 mdt.	0600-0700	Buenos Aires, Argentina	G	9.69 (MonFri.)
11:25 p.m1:25 a.m.	0625-0825	**Kuala, Lumpur, Malaysia	G	15.275
11:30 p.m12:50, a.m.		**Hilversum, Hotland	G	9.63 (via Bonaire)
12:00-12:15 a.m.	0700-0715	Tokyo, Japan	G	9.505
1:00-1:15 a.m.	0800-0815	"Tokyo, Japan	G	9.505
1:00-2:20 a.m.	0800-0910	**Hilversum, Holland	G	9.715 (via Bonaire)
1:00-3:00 a.m.	0800-1000		F	
1:00-7:00 a.m.	0800-1000	Manila, Philippines (FEBC) ***Port Moresby,	G	11,92 *
		Papia-New Guinea		4.89
2:00-2:15 a.m.	0900-0915	Tokyo, Japan	G	9.505
2:30-2:50 a.m.	0930-0950	**Sentiago, Chila	G	6.195, 9.566, 11.81, 15.15
3:00-3:30 a.m.	1000-1030	Tokyo, Japan	G	5.99

^{*}Reception quality, East Coast (West Coast) location: G-good, F-fair, P-poor

6.195, 9.566, 11.81, 15.15

1050-1110

Days refer to local date in target area.

3:50-4:10 a.m.

^{**}Not intended for North America, but receivable satisfactorily

ELECTRONICS MARKET PLACE

REGULAR CLASSIFIED: COMMERCIAL RATE: For firms or individuals offering commercial products or services, \$2.25 per word. Minimum order \$33.75 EXPAND-AD CLASSIFIED RATE: \$3.35 per word. Minimum order \$50.25. Frequency discount; 5% for 6 months; 10% for 12 months paid in advance. READER RATE: For individuals with a personal item to buy or sell, \$1.35 per word. No minimum! DISPLAY CLASSIFIED: 1" by 1 column (2-1/4" wide), \$260.00. 2" by 1 column, \$520.00. 3" by 1 column, \$780.00. Advertiser to supply film positives. For frequency rates, please inquire.

GENERAL INFORMATION: Payment must accompany copy except when ads are placed by accredited advertising agencies. First word in all ads set in caps. All copy subject to publisher's approval. All advertisers using Post Office Boxes in their addresses MUST supply publisher with permanent address and telephone number before ad can be run. Advertisements will not be published which advertise or promote the use of devices for the surreptitious interception of communications. Ads are not acknowledged. They will appear in first issue to go to press after closing date. Closing Date: 1st of the 2nd month preceding cover date (for example, March issue closes January 1st. Send order and remittance to POPULAR ELECTRONICS, One Park Avenue, New York, New York 10016, Attention: Hal Cymes.

FOR SALE

FREE! Bargain Catalog-I.C.'s, LED's, readouts, fiber optics, calculators parts & kits, semiconductors, parts, Poly Paks, Box 942PE, Lynnfield, Mass. 01940.

GOVERNMENT and industrial surplus receivers. transmitters, snooperscopes, electronic parts, Picture Catalog 25 cents. Meshna, Nahant, Mass. 01908.

LOWEST Prices Electronic Parts. Confidential Catalog Free. KNAPP, 3174 8th Ave. S.W., Largo, Fla. 33540.

ELECTRONIC PARTS, semiconductors, kits. FREE FLYER. Large catalog \$1.00 deposit. BIGELOW ELECTRONICS, Bluffton, Ohio 45817

RADIO-T.V. Tubes-36 cents each. Send for free catalog. Cornell, 4213 University, San Diego, Calif. 92105.

AMATEUR SCIENTISTS, Electronics Experimenters, Science Fair Students...Construction plans-Complete. including drawings, schematics, parts list with prices and sources Robot Man - Psychedelic shows -Emotion /Lie Detector — Touch Tone Dial — Quadraphonic Adapter — Transistorized Ignition — Burglar Alarm — Sound Meter,..over 60 items. Send 50 cents coin (no stamps) for complete catalog. Technical Writers Group, Box 5994, University Station, Raleigh, N.C. 27607

METERS-Surplus, new, used, panel or portable. Send for list. Hanchett, Box 5577, Riverside, CA 92507.

MECHANICAL, ELECTRONIC devices catalog 10 cents. Greatest Values - Lowest Prices. Fertik's, 5249 "D", Philadelphia, Pa. 19120.

SOUND SYNTHESIZER KITS—Surf \$12.95, Wind \$12.95, Wind Chimes \$17.95, Electronic Songbird \$6.95, Musical Accessories, many more. Catalog free, PAIA Electronics, Box J14359, Oklahoma City, OK 73114.

BUGGED??? New locator finds them fast. Write. Clifton. 11500-L N.W. 7th Avenue, Miami, Florida 33168.

YOU WILL SAVE BIG MONEY! Surplus, Clearouts, Bankruptcy, Inventory, Deals. Catalog \$1 (redeemable). ETCOA Electronics, Box 741, Montreal, H3C 2V2. U.S. Inquiries

HEAR POLICE/FIRE Dispatchers! Catalog shows exclusive directories of "confidential" channels, scanners. Send postage stamp. Communications, Box 56-PE, Commack, N.Y. 11725.

UNSCRAMBLERS: Fits any scanner or monitor, easily adjusts to all scrambled frequencies. Only 4" square \$29.95, fully quaranteed. Dealer inquiries welcomed, PDQ Electronics, Box 841, North Little Rock, Arkansas 72115. RECONDITIONED Test Equipment, \$0.50 for catalog. Walter's Test Equipment, 2697 Nickel, San Pablo, CA

POLICE, Fire monitors, scanners, crystals, CB Transceivers, New Crystal-less scanners. Discount priced. Box 19224, Denver, CO 80219.

TELETYPE EQUIPMENT for sale for beginners and experienced computer enthusiast. Teletype machines, parts, supplies. Catalogue \$1.00 to: ATLANTIC SALES, 3730 Nautilus Ave., Brooklyn, NY 11224. Tel: (212) 372-0349.

JAPANESE TRANSISTORS, all transistors original factory made. Free catalog. West Pacific Electronics, P.O. Box 3879, Torrance, CA 90510.

ELECTRONIC ignition: Capacitor-Discharge, pointless. Auburn Sparkplugs. Wheel Stabilizers. Information 20 cents. Anderson Engineering, Epsom, N.H. 03234.

WHOLESALE C.B., Scanners, Antennas, Catalog 25 cents. Crystals: Special cut, \$4.95, Monitor \$3.95. Send make, model, frequency, G. Enterprises, Box 461P, Clearfield, UT

COMPUTER HOBBYISTS—classified advertising newsletter. \$3.75/year. Free Sample. ON_LINE, 24695 Santa Cruz Hwy., Los Gatos, CA 95030.

SURPLUS COMPONENTS, Communication and test equipment. Illustrated catalog 25 cents. E. French, P.O. Box 249, Aurora, Illinois 60505.



ORGAN KITS **KEYBOARDS**

THE ULTIMATE IN DESIGN AND SOUND

Demo Record & Brochure \$1.00

DEVTRONIX ORGAN PRODUCTS, Dept. C 5872 Amapola Dr. . San Jose, CA 95129

SURPLUS 'SMART' TERMINALS, components, serious music synthesizer kits, plans, parts, and more. Send SASE for FREE INFO Package. CFR Associates, POBF, Newton, N.H. 03858.

CB RADIOS, monitors, crystals, CD ignitions. Southland, Box 3591-B, Baytown, Texas 77520.

CB CRYSTALS over 20,000 standard and specials in stock from 6.0 MHz to 45.0 MHz. Call or write for information package. Dealer inquiries invited. Roberts Electronics Sales, 73563 29 Palms Highway, 29 Palms, California 92277. (714) 367-6235.

SURPRISES GALORE! Projects, ham radio, music synthesizers, etc. IC's, pots, hardware, crystals, keyboards, resistors, etc. Send 13 cents stamp for catalogue. UTEP, Box 26231B, Salt Lake City, Utah 84125.

BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%.

Send for our free, tact-packed 40-page catalog/manual and learn how to assemble your own multi-element stereo speakers from scratch or from kits Dur catalog includes hapters on design, construction, x-overs, enclosures, midranges, woofers, tweeters and horns. Write us today

SPEAKERLAB Dept. PE-A, 5500 35th N E



BUILD AND SAVE. TELEPHONES, TELEVISION, DETEC-TIVE, BROADCAST Electronics. We sell construction plans with an Engineering Service. Speakerphones, Answering Machines, Carphones, Phonevision, Dialers, Color TV Converters, VTR, Games, \$25 TV Camera, Electron Microscope, Special Effects Generator, Time Base Corrector, Chroma Key. Engineering Courses in Telephone, Integrated Circuits, Detective Electronics, PLUS MUCH MORE. NEW Super Hobby Catalog PLUS year's subscription to Electronic News Letter, \$1.00. Don Britton Enterprises, 6200 Wilshire Blvd., Los Angeles, Calif. 90048.

NAME BRAND Digital/Analog Test Equipment. Discount prices. Free catalog. Salen Electronics, Box 82. Skokie, II-

TELEPHONES UNLIMITED, Equipment, Supplies, All types, Regular, Keyed, Modular. Catalog 50 cents. Box 1147E, San Diego, California 92112.

CB RADIOS-Police Scanners, Wholesale only!! Send letterhead for lowest prices anywhere. Four Wheeler, 10PE New Scotland, Albany, N.Y. 12208.



NEWTONIAN WIDE FIELD REFLECTOR TELESCOPE

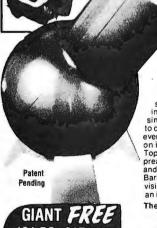
Clear, bright, spectacular wide angle views of stars, moon, comets . . . easy to use . . . portable!

IN SECONDS YOU'RE SCANNING THE ASTOUNDING UNIVERSE, able to see and study the breath-taking cosmos as perhaps you never have before ... awesome vastness, unbelievable orderliness, stark silent beauty. All the fascinating heavenly mysteries are yours to enter and explore. This new reflector telescope makes it easy for everyone to span a thousand light-years to space-age enjoyment of the heavens and outdoors. No complicated set up! Just is single view than any other type of telescope. Bright, crisp, finely resolved images to capture your interest and imagination. It's probably the easiest to use telescope ever... over your shoulder, in your lap, on a tripod. Or just rotate the spherical base on its own mount for use on a table, car hood. Take it anywhere (only 17", 10 lb.). Top quality optical system: 4½", f/4 parabolic primary mirror (½ wave, 17" F.L.); prealigned ½ wave diagonal on a coated optical window seals optics from moisture and dust; 28mm Kellner eyepiece (gives 15X, higher without other eyepiece or Sarlow). Fast focusing (25' to infinity). Bright Scharfanian red (doesn't impair night vision); adj. carrying strap. A "first" scope "must" an ideal second scope! IN SECONDS YOU'RE SCANNING THE ASTOUNDING UNIVERSE, able to

There is no other telescope like it. NO. 2001AV

COMPLETE AN	D MAIL COUPON NOW
EDMUND SCIENTIFIC CO. 30	O Edscorp Bldg., Barrington, N. J. 08007 Send me:
	"unique Edmund Telescope(s) #2001AV '@ \$149.95 ea \$
Charge my American Exp. BankAmericard Master Charge	Service & Handling Charge \$ 1.00 Enclosed is □ Check □ M.O. For TOTAL of \$
Interbank No.	Signature
Card No	
30-DAY MONEY-BACK GUAR- ANTEE. You must be satis-	Address
fied or return any purchase	CityZip

HELPING TO DEVELOP AMERICA'S TECHNOLOGY FOR OVER 30 YEARS.



164 PG. CATALOG

4500 UNUSUAL BARGAINS FOR HOBBYISTS. SCHOOLS, INDUSTRY

EDMUND SCIENTIFIC CO 300 Edscorp Bldg Barrington N.J. 08007 America's Greatest

Science • Optics • Hobby Center (609) 547-3488

EVK 99

MICRO MINI MIKE WIRELESS MICROPHONE

World's smallest; solid state, self-contained. Picks up and transmits most sounds without wires up to 300 ft, through FM Radio. Use as mike, ampf., alarm & alert sys., hot line, baby sitter, etc. Money back guar. B/A, M/C cds, COD ok. \$19.59 plus \$1.00 post. & hdlg. Calif. res. add tax. Mail orders only. Qty. Disc. Avail. AMC SALES, INC. 244" x 44" x 42" Dent. 23, Box 328 - Downey, Calif. 90241

POWERFUL, ADJUSTABLE, REGULATED, THREE OUT-PUT POWER SUPPLY and 900 easily removable parts in complete CARTRIVISION television recorder electronic with documentation. Perfect for assembly MICROPROCESSOR, IC, transistor, television, CB radio applications. \$21.45. Free brochure. MADISON ELEC-TRONICS, INCORPORATED, 369, D55, Madison, Alabama 35758. SATISFACTION GUARANTEED.

WIRE-Hookup, wire-wrap, ribbon cable, connectors, etc. Send 13 cents stamp for complete list. Ram Electronics. Box 336-P. Brookhaven, N.Y. 11719.

DIAGRAM MANUALS, Television-Radio, twelve volumes, regular \$48.25 value, only \$19.85. Supreme Publication, 1760 Balsam, Highland Park, IL 60035.

DVANCED

Consist of the No. 100 to 100

Completely compatible to the EVK system. This board allows the user to add an additional parts he desires. It has \$400 holes, holds 94.16 pm. IC's or others on 2, 4, 6, 9" or greater centers. 2, 50 pm, 1, 20 pm flat cable, 1, 25 pm RS232.

7400 TTL

100 PIECES MIX TAKE 10% DISCOUNT 1000 PIECES MIX TAKE 15% DISCOUNT

UNIVERSAL KLUGE BOARD \$98.00

16K BYTE RAM BOARD \$77.95

6 SLOT MOTHER BOARD \$29.95 EXTENDER BOARD \$46.50

TV PROJECTION Lens with detailed instructions, \$15.95. Info: JG Color TV, Box 63, Montgomery, N.Y. 12549.

CARBON FILM RESISTORS 1/4W, 1/2W - 1.7 cents each. FREE sample / specifications. Other components. COM-PONENTS CENTER, Box 134P, New York, N.Y. 10038.

WEATHER MAP RECORDERS (FACSIMILE) removed from commercial service. Copy latest National and Local Weather information also Satellite Photographs. Learn how! Send \$1.00. Complete details. Atlantic Sales, 3730 Nautilus Avenue, Brooklyn, N.Y. 11224. Tel: (212) 372-0349.



MICROPROCESSOR PRODUCTS

SPECIAL

RF MODULATOR MODULE

DC Switchable DC Coupled modulation Input with VSWR * 2 max popular transfer characteristic MCC * 6.5 water. Deband for use with TV Germa.

To convert your video composite to RF by UM 1071 Channel 3/4 VHF Modulator

BUY 10 OF THE FOLLOWING AND YOUR PRICE IS. . .

ONLY

ONLY

\$49.95

COMPLETE

TV GAME KITS

Pt business and plus instructions and plus instructions and the Court of the Court

SPECIALS

* CMOS

PLESSEY SEMICONDUCTORS

RADIO COMMUNICATION

DIVIDERS

\$1.1610C 1.95 \$1.1611C 1.95 \$1.1612C 1.95 \$1.1613C 2.40 \$1.1620C 2.95 \$1.1620C 2.95 \$1.1622C 2.95 \$1.1623C 2.95

Qty (1) GI AY38500 1 TV Game Chip \$29.95

TV KIT NO.1
Includes A V38500 1 TV GameChip
PC Board for video composite output
S34.95
plus instructions. Add 35 95 for 28th t crystal.

AMI EVK 99 6800 BASED MICROCOMPUTER

Photo of

expanded EVK 99

NOW \$133.00

I C MARKET PLACE

* LINEAR

rew Computer Dub in Santa why they choose the EVK B They now have 85 systems. Performance, versatisfy an Photo is of expanded EVK 99 Board

TV CAMERAS \$125 (new). Cartrivision video heads, \$12. Jutomation Systems, 124 Lundy Lane, Palo Alto, Calif. 94306.

MORSE KEYBOARD Software, CDP-1802, 256 Bytes, \$3.00. WA6UYV, 4956 Andrea Blvd., Sacramento, CA 95842.

20 KEY ITEMS of transistor circuits. Fifty pages of inside little known facts. Send \$5.95. No COD. Rebekron, 511 Coachlight, Hazelwood, MO 63042.

MAY GOODIES: 555-39 cents, 741-29 cents, 747-49 cents. Fairchild jumbo LED's red 12/\$1, green 8/\$1, 2N3055-88 cents. Free catalog. DIAMONDBACK, Box 194P, Spring Valley, IL 61362

ANYONE CAN SOLDER WITH-DO-IT-YOURSELFERS!

Let Kester solder aid you in your home repairs or hobbies. A radio, TV, model train, jewelry, plumbing, etc. Save money — repair it yourself. Send self-addressed stamped envelope to Kester for a FREE Copy of "Soldering Simplified".

KESTER SOLDER / 4201 Wrightwood Ave.

FREE CATALOG, Solar Cells, Ni Cads, Kits, Calculators, Digital Watch Modules, Ultrasonics, Strobes, LEDS, Transistors. IC's. Unique Components. Chaney's, Box 27038. Denver, Colorado 80227.

BUILD YOUR own cushion couch send \$3.95 to: Custom Craft, 3819 Burke Ave. N, Seattle, WA 98103 for complete plans and assembly instructions.

FREQUENCY ALLOCATION CHART 2Khz-200Ghz. Send \$2.00, Collins Chart Co., Box 1067, Coronado, CA 92118.

24 HOUR CB CRYSTAL

Thousands of specials in stock. Regulars too. FREE CATALOG. Phone orders: (612) 633-1318, 8:00 A.M. - 10:00 A.M. CST. FBCO - 2928-14th St. N.W. New Brighton, MN. 55112

EPROM 5203Q \$6.00, 5213 Character Generators \$6.00, 63XX Series ROMS, TTL, MOS, 64KBiT Memory Boards \$40.00. Cartrivision TV Cameras and many other parts. Free Brochure. Alteer Electronics, Box 60716, Sunnyvale, California 94088





ALTAIR /IMSAI COMPATIBLE 8K MEMORY 8K MEMORY
Our naw brain board comes complete with
21L02-1 memory chips (500ns) and sockets
Al) address control and data out lines fully
buffered.

\$198.00 COMPLETE

6800 STARTER SET

Only 68 Buchs \$68.00 You Get 111 6800 8 Int CPU 111 6820 PIA 111 6850 ACIA (161 2102 RAMs

80804 STARTER SET Only \$80.00 You Get 111 8080A 8 bit CPU 111 8212 1 0 Port 111 8224 Clock 111 8229 System Controlle 124 7102 RAMs

All shipments first class or UPS in U.S. or add 5% for shipping and handling. Minimum order \$10.00 California Residents add 6% tax. Foreign add 8%.

ADVANCED

* MICROCOMPUTER
P. O. BOX 17329
IRVINE, CALIFORNIA 92713
PHONE (714) 968-3665



DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC. Send for free catalog. LYLE CARTRIDGES, Dept. P, Box 69. Kensington Station, Brooklyn, New York 11218. SAVE 50% build your own speaker system write: McGee Radio Electronics, 1901 McGee Street, Kansas City, Missouri 64108.

MIXERS — Preamps — Speakers. Top Quality Kits — Plans — Parts. Send 25 cents for catalog. Audio Design & Engineering Co., P.O. Box 154, Lee, Mass. 01238. (413) 243-1333

RECTILINEAR RESEARCH CORP. would appreciate comments from interested parties on the feasibility of offering our highly rated Models 5a and 7a fully assembled, wired and tested LESS CABINET at very substantial savings. Freight prepaid within UPS zone. Detailed drawings for enclosure included. Franchised or non-franchised dealers can participate. To assist in this survey, write: Kit Division/PE, Rectilinear, 107 Bruckner Boulevard, Bronx, N.Y. 10454. (212) 585-9400.

FREE INFORMATION:

Learning more about a product that's advertised or mentioned in an article in this month's issue is as simple as one, two, three. And absolutely free.

per person.

1

Print or type your name and address on the attached, card.
Use only one card

2

Circle the number(s) on the card that correspond to the number(s) at the bottom of the advertisement or article for which you want more information. (Key numbers for advertised products also appear in the Advertisers' Index.)



Simply mail the card.

This address is for our product Free Information Service only. Editorial inquiries should be directed to POPULAR ELECTRONICS, One Park Avenue, New York, N.Y. 10016.

Use only one card per person

NA	ME							1.0	ЕСЭСТИ		-			_
AL	H	RES	55_	_									_	
CIT		Trace !	lan in	retuele	nd to	S	TAT	TE.	1 160		(-)	ZIF	100	
(Zip	Confe	111021	oe o	icique	30 10	HISLIT	e cien	very.	· (V	old a	iter Ji	TIA 3	1, 197	(/)
Do yo equip						utpu	rchas	ing e	lectro	nic				
□ Pi	eose s	end r	ne 12		s of l		ar Ele			or \$6			-	
16	17	18	19	20	21		23		25	-		-		15 30
31		33			36		38					77	-73	100
46		48	-		51			100		56	100	100		
61	62	63	64	65	66	67	68	69	70	71	-		100	-
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
91	92	-	94						100					
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
PC Use or	PL	cand	A F	E	LE	CI	R	NC.	IIC	S			PE5	772
NA	ME	Ξ_						_						
AL	DF	RES	S_											
CIT	·v					6	TAT	TE				ZIF		
Doyo	u adv	vise o	ther p	eople	e abo	ut pu	rchas	ing e	lectro	nic				
equip	ment	? [Yes		No							nd bi	II me.	
quip	ment		Yes		No				nias I			nd bi 13	II me.	15
quip	ment ease s	end r	Yes ne 12	? issue	No es of l	Popu	lar El	ectro	nias I	or Se	5.99 a 12		14	
quip	ment ease s	end r	Yes ne 12 4	issue 5	No es of I	Popu 7	lar El	ectro 9	nics I	or \$6	5.99 a 12	13	14	15
quip PI 1 16	ease s	end r 3	Yes ne 12 4 19	5 20	No 6 21	Popu 7 22	8 23	9 24 39	10 25 40 55	or \$6 11 26	5.99 a 12 27	13 28	14 29	15 30
1 16 31 46 61	2 17 32 47 62	3 18 33 48 63	19 34 49 64	5 20 35 50 65	6 21 36 51 66	7 22 37 52 67	8 23 38 53 68	9 24 39 54 69	10 25 40 55 70	or \$6 11 26 41 56 71	5.99 a 12 27 42 57 72	13 28 43 58 73	14 29 44 59 74	15 30 45 60 75
1 16 31 46 61 76	2 17 32 47 62	3 18 33 48 63 78	Yes 12 4 19 34 49 64 79	5 20 35 50 65 80	6 21 36 51 66 81	7 22 37 52 67 82	8 23 38 53 68 83	9 24 39 54 69 84	10 25 40 55 70 85	or \$6 11 26 41 56 71 86	5.99 a 12 27 42 57 72 87	13 28 43 58 73 88	14 29 44 59 74 89	15 30 45 60 75 90
1 16 31 46 61 76	17 32 47 62 77 92	3 18 33 48 63 78 93	Yes 12 4 19 34 49 64 79	5 20 35 50 65 80 95	66 81 96	7 22 37 52 67 82 97	8 23 38 53 68 83 98	9 24 39 54 69 84	10 25 40 55 70 85 100	or \$6 11 26 41 56 71 86	5.99 a 12 27 42 57 72 87	13 28 43 58 73 88 103	14 29 44 59 74 89 104	15 30 45 60 75 90 105
1 16 31 46 61 76 91 106	2 17 32 47 62 77 92 107	3 18 33 48 63 78 93 108	19 34 49 64 79 94	5 20 35 50 65 80 95 110	81 96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113	9 24 39 54 69 84 99 114	10 25 40 55 70 85 100 115	or S6 11 26 41 56 71 86 101 116	5.99 a 12 27 42 57 72 87	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104	15 30 45 60 75 90 105 120
1 16 31 46 61 76 91 106	2 17 32 47 62 77 92 107	3 18 33 48 63 78 93 108	19 34 49 64 79 94	5 20 35 50 65 80 95 110	81 96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113	9 24 39 54 69 84 99 114	10 25 40 55 70 85 100	or S6 11 26 41 56 71 86 101 116	5.99 a 12 27 42 57 72 87	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104 119	15 30 45 60 75 90 105 120
PP 1 16 31 46 61 76 91 106 PC Use of NA	2 17 32 47 62 77 92 107	3 18 33 48 63 78 93 108	19 34 49 64 79 94 109	5 20 35 50 65 80 95 110	81 96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113	9 24 39 54 69 84 99 114	10 25 40 55 70 85 100 115	or S6 11 26 41 56 71 86 101 116	5.99 a 12 27 42 57 72 87	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104 119	15 30 45 60 75 90 105 120
PP 1 16 31 46 61 76 91 106 PC Use of NA	2 17 32 47 62 77 92 107 INTE	3 18 33 48 63 78 93 108	19 34 49 64 79 94 109	5 20 35 50 65 80 95 110	81 96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113	9 24 39 54 69 84 99 114	10 25 40 55 70 85 100 115	11 26 41 56 71 86 101 116	5.99 a 12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120
1 16 31 46 61 76 91 106 PC Use of NA	2 17 32 47 62 77 92 107 IDF	3 18 33 48 63 78 93 108	19 34 49 64 79 94 109	5 20 35 50 65 80 95 110	96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113 FRI	9 24 39 54 69 84 99 114	10 25 40 55 70 85 100 115	11 26 41 56 71 86 101 116	12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120
1 16 31 46 61 76 91 106 NA	2 17 32 47 62 77 92 107 ME	3 18 33 48 63 78 93 108 IL.	Yes 19 34 49 64 79 94 109 AF per pe	5 20 35 50 65 80 95 110 E Earson	96 111	7 22 37 52 67 82 97 112	8 23 38 53 68 83 98 113 FRI COSTA	9 24 39 54 69 84 99 114 DN	100 25 40 55 70 85 100 115	or \$6 11 26 41 56 71 86 101 116	12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120
1 16 31 46 61 76 91 106 NA	ease : 2 17 32 47 62 77 92 107 PIPP Code	3 18 33 48 63 78 93 108 E = must	Yes 19 34 49 64 79 94 109 AF per pe be in	5 20 35 50 65 80 95 110 Eerson	96 to ee abo	7 22 37 52 67 82 97 112 C	8 23 38 53 68 83 98 113 FRI	9 24 39 54 69 84 99 114 DIN	100 25 40 55 70 85 100 115	or \$6 11 26 41 56 71 86 101 116	12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118 	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120 771
PI 16 31 46 61 76 91 106 NA	ease : 2 17 32 47 62 77 92 107 PIPP Code	3 18 33 48 63 78 93 108 IL.	Yes 19 34 49 64 79 94 109 AF per pe be in	2 issue 5 20 35 50 65 80 95 110 E E reson	96 to ee abo	7 22 37 52 67 82 97 112 C	8 23 38 53 68 83 98 113 FRI ATA	9 24 39 54 69 84 99 114 DEN	100 25 40 55 70 85 100 115	or \$60 \$60 \$60 \$60 \$60 \$60 \$60 \$60 \$60 \$60	12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118 ZIF	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120 7771
1 16 31 46 61 76 91 106 PC (Zip Coo you equip Coo you equip Coo you equip Coo you con the coop Coop Coop Coop Coop Coop Coop Coop	ease : 2 17 32 47 62 77 92 107 PIPPI Code u add ment	3 18 33 48 63 78 93 108 E Card E Send 7 2 5 5 5 6 6 6 7 6 7 6 7 6 7 6 7 6 7 6 7 6	19 34 49 64 79 94 109 be in the () Yes	5 20 35 50 65 80 95 110 EE Colude Colude Colude Colude Colude Colude Columbia	80 of 16 6 81 96 111 1 LE	7 22 37 52 67 82 97 112 Sinsur put put Pepul 7 22	8 23 38 53 68 83 98 113 FRI A ce deli	9 24 39 54 69 84 99 114 DEN 114 PROPERTY 115 115 115 115 115 115 115 115 115 11	100 25 40 55 70 85 100 115 115 110 110 110 110 110 110 11	or \$60 \$6 \$6 \$71 \$6 \$6 \$101 \$116 \$6 \$71 \$6 \$71 \$6 \$71 \$71 \$71 \$71 \$71 \$71 \$71 \$71 \$71 \$71	12 27 42 57 72 87 102 117	13 28 43 58 73 88 103 118 	14 29 44 59 74 89 104 119 PE5	15 30 45 60 75 90 105 120 7771

46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

61 62 63 64 65 66 67 68 69 70 71 72 73 74 75

76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120

Place 90 Stamp Here

Popular Electronics

P.O. Box 2905 Clinton, Iowa 52732

> Place 90 Stamp Here

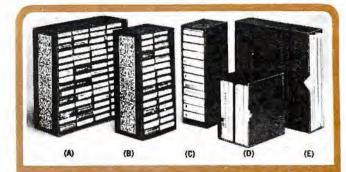
Popular Electronics

P.O. Box 2905 Clinton, Iowa 52732

> Place 90 Stamp Here

Popular Electronics

P.O. Box 2905 Clinton, Iowa 52732



A COMPLETE SET OF MATCHED STORAGE CASES

Here's the ideal solution to the problem of keeping all your records and tapes stored neatly, safely, conveniently and attractively. A complete set of matched storage cases, designed by the editors of STEREO REVIEW magazine, for your records and all your tapes: cassette, cartridge and 7" reel. Now you can keep them side-byside on your bookshelf or cabinet, easy to identify and readily available.

These cases are sturdily constructed and covered in a handsome leatherette. The outer case is elegantly embossed in gold and comes in your choice of three popular decorator colors-black, brown and green-so that they lend themselves readily to the decor of any room.

STEREO REVIEW large capacity storage cases are just what you've been looking for-they're the ideal solution to keeping your records and tapes neatly stored for easy use.

- (A) 60-unit cassette case 13½" high x 12¾" deep x 5½" wide. \$17.95 each; 3 for \$49.95.
- (B) 30-unit cassette case. 131/2" high x 61/2" deep x 51/2" wide. \$12.95 each; 3 for \$34.95.
- (C) 12-unit 8-track cartridge case. 131/4" high x 61/2" deep x 41/2" wide, \$9.50 each; 3 for \$24.95,
- Units A, B and C have tilted compartments to prevent spillage and include pressure sensitive labels for titling.
- (D) 6-unit 7" reel case. 8" high x 71/2" deep x 5" wide. Holds reels in original boxes, \$6.95 each; 3 for \$18.50.
- (E) 20-unit 12" record case, 131/4" high x 121/2" deep x 31/2" wide. Holds records in original jackets. \$7.50 each; 3 for \$19.95.

HERE'S HOW TO ORDER

CASH: Mail your order along with your name, address and remittance in the amounts indicated above for the units being ordered. PRICES INCLUDE ALL POSTAGE AND HANDLING CHARGES OUTSIDE U.S.A. ADD \$1 PER UNIT ORDERED. Residents of Calif., Col., Fla., III., Mich., Mo., N.Y. State, D.C. and Tex. add applicable sales tax.

CHARGE: Your American Express, BankAmericard, Master Charge or Diners Club account. Mail your order, name, address, credit card number and expiration date (Master Charge customers include four-digit Interbank =). Be sure your signature is on your order. You will be billed in the amounts indicated above



Identify the type of case ordered and indicate your color choice for the back of the case-black, green or brown (sides in black only).

MAIL ORDERS TO ZIFF-DAVIS CONSUMER SERVICE DIVISION DEPT. SV, 595 BROADWAY, NEW YORK, N.Y. 10012



MAY 1977

	CRYST		G,
Parl #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33 U	\$5.95
CY2A	2.000 MHz	HC33 U	\$5 95
CY3A	4.000 MHz	HC18 U	\$4 95
CY7A	5.000 MHz	HC18 U	\$4.95
CY12A	10.000 MHz	HC18 U	S4 95
CY14A	14.31818 MHz	HC18U	54 95
CY19A	18,000 MHz	HC18 U	\$4 95
CY22A	20,000 MHz	HC18 U	\$4 95
CY30B	32,000 MHz	HC18 U	\$4 95

XR-2206KB	Kit \$27	7.95	XR-	2206KA Kit	\$17.95
WAVEFO DENERATE	ORS	EXA	٩R	XR-555CP XR-320P	R\$ \$ 9 1.55
XR-205 XR-2206CP	\$8 40 4 49			XR-556CP	1.85
XR-2207CP	3 85	MISCELLAI	IEDUS	XR-2556CP	3.20
		XR-2211GP	\$6.70	XR-2240CP	3 25
STEREO DEC	CODERS	XR-4136	99	PHASE LOCK	
xR-1310CP	\$3.20	XR-1468	3 85	XR-210	5 20
XR-1310EP	3 20	XR-1488	5 80	XR-215	6 60
XR-1800P	3 20	XR-1489	4.80	XR-567CP	1 95
XR-2567	2 99	XR-2208	5 20	XR-5670T	1 70

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

.156 Spacing-Tin-Double Read-Out Biturcated Contacts — Fits .054 to .070 P.C. Cards PINS (Solder Eyelet) \$1.95 18/36 PINS (Solder Eyelet) \$2.49

22/44 PINS (Solder Eyelet) 50/100 (.100 Spacing) PINS (Solder Eyelet) \$6.95 25 PIN-D SUBMINATURE

DB25P DB25S SOCKET \$4.95 31/2 DIGIT DVM KIT





This 0-2 YDC .05 per cent digital voltmeter features the Motorola 3½ digit DVM chip set. It has a .4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with Bezel. An optional power supply is available sinto the same case as the 0-2V DVM allowing 117 VAC operation

A. 0-2V DVM with Case **B. 5V Power Supply**

\$49.95 \$14.95

VECTOR WIRING PENCIL

not which is used to quide and wrop estudents were will off a self-content or personal replacement leads or terminate installed on pre-punched P. Planes received by the procession of the procession of the personal resolution between the wropped wine and component leads pals or exterminable are made by solidering. Complete with 250 FT of red water \$9.50

REPLACEMENT	WIRE	- BO	BBINS	FOR WIRI	NG PENCIL	
W36-3-A-Pkg	3	250 ft	36 AW	G GREEN	\$2.40	
W36-3-B-Pkg	3	250 ft	36 AW	G RED	\$2.40	
W36-3-C-Pkg		250 ft	35 AW	G CLEAR	\$2.40	
INDE 2 D Due		250 0	26 AW	C RILLIE	62 40	

	1/16 VECT	OR E	OAR	D			
*****	0.1" Hole Spacing	P-P	attern	P	Price		
411.12	Part No	Ł	W	1	2-Up		
PHENOLIC	64P44 062XXXP	4 50	6 50	1 72	1 54		
	169P44 02XXXP	4 50	17 00	3 69	3 32		
EPOXY	54P44 062	4 50	6 50	20;	1 B6		
GLASS	84P44 082	4 50	8 50	2 56	2.31		
	169P44 062	4 50	17 00	5 04	4 53		
	169P84 062	8 50	17 00	9 23	8 26		
EPOYY GLASS	169P44 062C1	4 50	17 00	6 60	6 12		



291-.36H Alumunum Heat Sink for TO-220 Transistors & Regulators \$.25 680-.75A Black Anotherd Aluminum

HEXADECIMAL ENCODER 19-KEY PAD



- ARCDEF
- · Return Key
- · Optional Key (Period)
- Key

\$10.95 each

63 KEY KEYBOARD

This keyboard feature: 63 men ruded 5PST km, unattacheft to any kmil of P is at A very solid morbed plastic 13 ix 4 base

\$19.95

100165 16 LINE TO FOUR BIT PARALLEL KEYBOARD ENCOGER



JOYSTICK

potentiometers, that vary resistance proportional to the angle of the stick, Sturdy metal construction with plastics components only at the mova-ble joint. Perfect for electronic games and instrumentation.

*5K Pots \$6.95 *100K Pots \$7.95

MICROPROCESSOR COMPONENTS

\$19.95 8228 System Controller - Bus Driver \$10.95

8212 8214 8216 8224 CDP1802	8 Bit Input/Output Priority Interrupt Control Bi-Directional Bus Driver Clock Generator/Driver 2 - with user manual	4.95 15.95 6.95 10.95 39.95	MC6820L MC6810AF MC6830L7 Z80 C	1 128 x 8	Interface Adapter Static RAM 8 Bit ROM	35.00 15.00 6.00 18.00 49.95
	CPU'S				RAM'S	
8080	Super 8008	24 95	1101	256 1 1	Static	\$ 149
80804	Super 8008	19 95	2101	256 x 4	Star	5.95
			2102	1027 x T	5540	1 75
	SR'S		2107:5280	1394 x 1	Dan en	4.95
2504	1024 Dynamic	\$ 3 95	2111	250 + 4	5'41 =	5.95
2518	Hex 32 BIT	7 00	7489	L K TS	S. 18.	2 49
2519	Hex 48 BIT	4 00	8101	, nx4	Statu	6.95
2524	512 Dynamic	2.49	B\$11	255 x 4	State	6.95
2525	1024 Dynamic	5 00	5597	15 x 4	State	3 49
2527	Dual 256 BIT	3 95	91(0,	111, 1 g 1	at its	2 25
2529	Qual 512 817	4 00	1,500	, -f. x 1	stati	6 95
2512	Quad BO BIT	3 95	93421	56 x 1	21415	2 95 2 m 1 00
2633	1024 State	7 95	MM5262	2K a 1	Dynamic	2 40 1 00
3541	FAO	6 95			PROMS	
7415670	16 x 4 Reg	3 95	1702A	11.5 m	I are	\$ 9 95
			5203	. 146	· water	11: 19
	UART'S		B2S23	13 4 F	Special Control	5 00
41 5 1015	30k Baud	\$5 95	B2S123	1. 4 8	Irratate and	5.00
-			745287	1.124	Fast	3 95
	ROM'S		3601	256 ± 4	Eprom	34 95
14.1 4	Char Gen	\$ 9 95	6301-1	1024	To State Bipolar	3 49
7516	Char Gen	10.95	6350-1	256	Open Collector Bipplas	
745387	1024 Bit Programmable	1 95	63.31 1	256	In-State Bigotar	2 95

		SPECI	AL REQU	JESTED ITE	MS		
MC3061P	3 50	CD4508	6 75	625115	25 00	3341	6 95
MC4016P (74416)	7 50	CD4515	6 50	5841	9 95	9368	3 95
MC14583	3 50	CD4520	2 70	MK5024D	17 50	MC1408L7	9 95
MC14562	14 50	MCM6571	17.50	11090	19 95	LD110/LD111	25 00/set
CD4059	9 95	MCM6574	17 50	DS0026CH	3 75	AY-5-9100	17 50 ea
CD4070	95	MCM6575	17 50	TIL308	10 50	95H90	13 95

ELECTRONIC 'PENDULUM' CLOCK

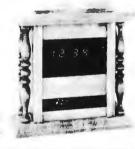
- Unique Electronic 'Swing' Pendulum
- Real Furniture Quality
- Handicrafted Unfinished Wood Case
- Large .7" Hours, and Minutes LED Display
- Alarm Feature
- 12 or 24 Hour Mode Time Set Push Buttons
- Use Module For Easy Assembly
- Special programed ROM in pendulum for animated effect!

Dimensions - 101/4" x 101/2" x 31/4"

KIT - UNFINISHED*

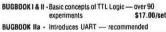
\$59.95

ASSEMBLED — STAINED* \$69.95



BUGBOOK ®

Continuing Education Series



for RTTY enthusiast BUGBOOK III - Explores 8080 chip - introduces Mark 80 Microcomputer \$15.00/book 555 TIMER APPLICATIONS SOURCEBOOK WITH

\$5.00/book

\$4.50

EXPERIMENTS - over 100 design techniques \$6.95/book CMOS-M-DESIGNERS PRIMER AND HANDBOOK a complete CMOS instruction manual

Introductory Offer - all 6 books (worth \$49.95)

14 PIN

16 PIN

CONTINENTAL SPECIALTIES PROTO BOARD 6 Other CS Proto Boards PROTO CLIPS

long X 4" wide)

\$15.95

\$ 19.95 PB100 - 4.5" x 6" PB101 - 5.8" x 4.5" 29.95 PB102 - 7" x 4.5" PB103 - 9" x 6" PB104 - 9.5" x 8" PB203 - 9.75 x 61/2 x 21/4 PB203A - 9.75 x 6½ x 2¾ 120.00 (includes power supply) Logic Monitor

39.95 24 PIN DESIGN MATES 79 95 DM1 - Circuit Designer 75.00 54.95 DM2 - Function Generato DM3 - RC Bridge

QT PROTO STRIPS



\$5.00 Minimum Order — U.S. Funds Only California Residents — Add 6% Sales Tax

Spec Sheets - 25c — Send 35c Stamp for 1977A Catalog Dealer Discount Available — Request Pricing



ELECTRONICS

1021-A HOWARO AVE., SAN CARLOS, CA. 94070 PHONE OROERS WELCOME — (415) 592-8097 All Advarlised Prices Good Thru May



LOGIC ANALYZER KIT

Troubleshoot any type of digital system including Microcomputers.

(includes IC, power supply PC Board, case and manual LA100 KIT \$189.00

DIGITAL AUTO INSTRUMENT SEVEN DIFFERENT INSTRUMENTS! MEETS OR EXCEEDS ORIGINAL AUTOMOTIVE SPECS.

Please specify which one of the seven models you want when ordering - these do not all come in one unit. Each model must be bought separately.

TACHOMETER 1 0-9900 RPM 4, 6 or 8 Cyclinder

2 WATER TEMP FUEL LEVEL

5 OIL PRESSURE

4 0-99 MPH

7 BATTERY MONITOR

BRIGHT YELLOW ORANGE .3" LED DISPLAY!

KIT: \$49.95 DIMENSIONS 41/2 x 4 x 2 Add \$10 00 for required speed transducer ASSEMBLED: \$59.95

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
 Times to 59 minutes 59.59 seconds
 Crystal Controlled Time Base
 Three Stopwatches in One
 Three Stopwatches in One
 Three Stopwatches in One
 Three Stopwatches in One
- \$39.95 Kit __ Assembled - \$49.95

Heavy Duty Carry Case \$5.95



Stop Watch Chip Only (7205) \$19.95

1 Timeband

- DIGITAL ALARM CLOCK \$16.95
- 24-Hour Alarm
 "DOZE" Button
- Large Red Led Display (.8" high) AM/PM Indicator
- Seconds Display at touch of button
 SPECIFY BLACK OR IVORY



QUARTZ DIGITAL AUTO CLOCK OR ELAPSED TIMER!

Elapsed Timer: Hrs. Mins and Secs Elapsed Fimer: Ars, Mins and Se 12 or 24 Hr Capacity Simple Resel - Slart Pushbutton Control

omisets kit includes mounting bracket inject kit includes mounting practice; in and all components, nothing else to 5 Features MMS314 cmp Large 4 LED s causey better to an emin per mo interna-tivey hackup. 12 volt non-polar operation

DIMENSIONS 412 x 4 x 2 12 or 24 HOUR MODE



Assembled: \$39.95 CASE ONLY (includes hardware, mounting bracket and bezel) \$6.50



JE700 CLOCK

115 VAC

\$17.95

DIGITAL CLOCK KIT - 31/2 INCH DIGITS 4 DIGIT KIT \$49.95 A DIGIT ASSEMBLED SEQ OF 6 DIGIT ASSEMBLED \$79.95 6 DIGIT XIT \$69.95

This clock features big 3½" high digits for viewing in offices, auditoriums, etc. Each digit is formed by 31 bright 0.2" LED's. The clock operates from 117 VAC, has either 12 or 24 hr. operation. The 6 digit version is 27" x 3½" x 1½" and the 4 digit is 18" x 3½" x 1½" kits come complete with all components, case and transformer.

Specify 12 or 24 Hour When Ordering

JE803 PROBE

he Linux Probe is a unit which is for the most part he Logic Propo is a containing for the most pair. The Charles Booking of the Charles in the Cha

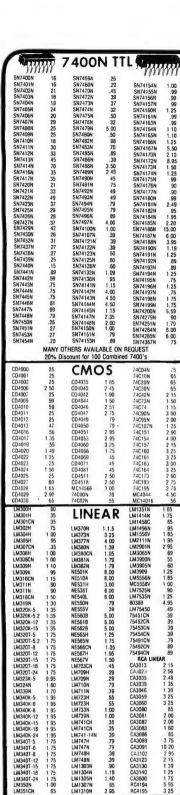


\$9.95 Per Kit printed circuit board



T²L 5V 1A Supply This is a standard TTL power supply using the well kind LM309K regulator IC to provide a solid 1 AMP of current volts. We try to make things easy for you by provide everything you need in one package, including the hardwiter only \$9.95 Per Kit

\$9.95 Per Kit



There is only one

ELECTRONICS

They can try and copy our ad, BUT They can't copy our service!

XC	209	125" dia. Red Green	10/\$1 4/\$1		E DIS	_	(150	_	=	XC111 XC111	Red Green	10/\$1
	209	Orange	4/\$1		n12	LH	FIF	LED	2		XC111	Vellow Orange	4/\$1
		.200" dia			.18	5" dia				.200" d		.085"	
	22	Red	10/\$1	XC526	Red		10/51	XC55	56	Red	10/\$1	MY50 - Re	
	222	Green	4/51	XC526	Gree		4/\$1	XC5.		Green	41\$1		
	22	Yellow	4/51	XC526	Yalk	W	4/\$1	XC5		Yellow	4/51	INFRA-RE	
	22	Orange	4/51	XC526	0rar		4/\$1	XC5		Orange	4 51	74 X 74	
SE	L-22	RT	4/\$1	XC526	Clea		4/51	XC5		Clear	7/51		5/\$1.00
	SP	ECIAL '	- X	C556 i	Red 1	00/5	8.00	11	000/	\$6 0.0	0 — SF	PECIAL	*
	DLTIT	4			פות	PI	ΔV	LEDS	2		G138	DE336	3
			1		טוט	-	~ 1	LLD)				
	TYPE	POLARI	TY		HT		1	TYPE	PO	LARITY		HT	
	MAN 1	Commo			270	.2 95		AAN 3640			ode-orange	300	1 75
	MAN 2		ot Matrix		300	4 95		AAN 4710		nman Ana		400	1 95
	MAN 3		n Cathode		125	1 00		L701		nmen Ano		300	99
	MAN 4		n Cathode		187	1 95)L704	Cor	nmen Cati	node	300	99
	MAN 7		n Anode		300	1 25		Jt 707		nmon Ano		300	99
	MAN 7G		n Anode-g		300	1 95		44N 4740	Con	nmon Ano	de-Red	400	99
	MAN 7Y		n Anode-y		300	1 95		H 741	Con	птоп Апо	de	600	1 50
	MAN 52		n Anode-g		300	99		747	One	1 1 45		500	2 25
	MAN 64		n Anode-re	ed .	400	99		750	Com	THE PARTY		600	2 49
	MAN 74		n Cathode		300	1 50		138		THE CAM		110	50
	MAN 82		n Angoz-yi		300	99		400-00		Total Cate		140	75
	MAN 84		n Cathode-		300	99		VD=0		Cha		100	1 00
	MAN 362	20 Commor	n Anode -c	epnar	300	1 75	5	MISS	Dire	100		500	1 00
B	Over 60	- 8's' x 1 each reusab eastors, Res	e de IC's estars.	ON	.95 e	a.	Selection Selection	display table angle I and bat s	is.	21 Th	1 TV (E Lead Dual the circuit is i	In Line intended to t	e battery
	ELUXE BI	ps, Crystals, DARD B O each reus	111 ₂ x 1	8 \$9	VAILABLE 1.95 e: LY 500 E	а.	 Reals 6 Gar 		ins he	to ckey/	rterna) con r complete s	ystem	
	isc Tran	estors, Rese ps Crystals	21012	A	VAILABLE			er squash uce and two				\$24	.95
						_ L0	W PR	OFILE (1	IN) S	OCKET			
		1-24	75-49	55-12	0						1-24	25-49	50-10
	Boin	\$ 17	16	15						24 pm	5 38	37	35
1	4 pin	20	19	18		•		-		28 pin	45	44	43

lactic Duch	Button Swit	MINATURE	TOGGL	F SWI	TCH
75 68	02	40 pm	1 75	1 55	1 40
43 42 75 68	62	36 pm	1 59	1 45	1 30
39 38	41	20 pm	1 40	1 25	1 10
S.45 41	37 37	24 par	\$1.05	95	85
		OCKETS (GOLD) LEVEL #3			
J. 4)			, /3	1 28	1 40
52 47	43	40 pin	1 75	1 59	1 45
35 32 38 35	29 32	36 pm	1 75	1 40	1 26
35 32	20	70	1.10	1 00	90
S.30 27	24	24 pin	\$ 70	63	57
	SDLDERTAI	L STANDARD (GOLD)			
49 45	42				
35 32	30	40 pm	1 59	1 45	1 30
30 27	25	36 pin	3 39	1 26	1 15
\$.27 25	24	28 pin	\$ 99	90	81
37 36		AIL STANDARD (TIN)			
29 28	27	40 pm	63	62	61
22 21	20	36 pm	60	59	26
20 19	18	28 pin	45	44	43 56 61
\$ 17 16	15	24 pm	5 38	37	35
		_			50.100
		TOM LUCLITE (114) POPER			
1-24	75-45	25-49 55-180	25.49 5/-100		25.49 5/1 this 1-24 25-49

10 pm	/3	00	×	
PI	* 18 AW	Push Butt G Solid Wire - ! Ide) X .60 (high	5" Long	
M		@ 14 Volt - 1		
V		_	1-9	10-Up
11	J-188-1	Push On-Push C	H 59	49
-	J-188-2	Normally Open	59	49
	J-188-3	Normally Closed	59	49

//	MAIUKE	106	are 9MI	ГСП
	JMT-221	DPDT	on/off/on	S1 9
42	JMT-223	DPDT	on/none/on	S1 7
-	JMT-121	SPDT	on/off/on	\$1 5
4444	JMT-123	SPDT	on/none/on	S1.2

	CLIPLITE LED MOUNTI	8/\$1.49 NG SYSTEM KC556 LEDS
Sprinty Colors	— Red - pres - Ambe	

•							de Actio			
	# 206	4	8	pin	digt.	4	switch	und	\$1.75	88
H	= 206		(14	pin	dipi	7	switch	#inu	\$1.95	83
_	# 206	8	116	inin.	d(p)	8	switch	unit	\$2.25	82
_			-	=	_					

50 PCS.	RES	ISTOR	ASSO	RTME	NTS	\$1.7	' 5	PER	ASST.
ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 QHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	1/4	WATT 5%	50 PCS.
ASST. 2	5 ea.	68 OHM 180 OHM	82 DHM 220 DHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 DHM	1/4	WATT 5%	50 PC\$.
ASST. 3	6 es.	470 OHM 1 2K	560 OHM 1 5K	680 OHM 1 8%	820 OHM 2 2K	1K 2 7K	1/4	WATT 5%	50 PCS.
ASST. 4	5 ea.	3 3K 8 2K	3 9K 10K	4 7K 12k	5 6K 15K	6 BK 18K	1/4	WATT 5%	50 PCS.
ASST. 5	S ea.	22K 56K	27K 68K	33K 82K	39k 100k	47% 120%	1/4	WATT 5%	50 PCS.
ASST. 6	5 ea.	150K 390K	180K 470K	220K 560K	270M 680K	330K 820%	1/4	WATT 5%	50 PCS.
ASST. 7	5 ea.	1M 2 7M	1 2M 3 3M	1 5M 3 9M	1 BM 4 7M	2 2M 5 6M	1/4	WATT 5%	SOPCS.
ASST. 8F	Incl	udes Re	sistor A	ssortme	ents 1-7	(350 PC	5.) \$	10.9	5 ea

\$5.00 Minimum Order — U.S. Funds Only California Residents — Add 6% Sales Tax

Spec Sheets - 25c — Send 35c Stamp for 1977A Catalog Dealer Discount Available — Request Pricing



WIRE WRAP CENTER

HOBBY-WRAP TOOL-BW-630



Battery Operated (Size C) Weighs ONLY 11 Ounces . Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch) Complete with built-in bit and sleeve

WIRE-WRAP KIT - WK-2-W WRAP . STRIP . UNWRAP

Tool for 30 AWG Wire Roll of 50 Ft, White or Blue 30 AWG Wire 50 pcs. each 1", 2", 3" & 4" lengths pre-stripped wire.

\$11.95



WIRE WRAP WIRE - 30 AWG



CUTTER CRIMPER TOOL (CS-8)

Plier Nose (serrated-jaw)
Scissors Action Cutting
6 Bolt Cutters (4-40, 5-40, 6-32, 8-32, 10-32, 10-24)

Crimp Stations (7mm Auto — 22-20 to

Crimp Stations (rhm Auto — 22-20 to 12-X0 elect.)

"Up-Front" Wire Cutting
Scissors Action Stripping (No. 22-20 to No. 10)
Crimp Stations — insulated (2w-20 to 12-10 elect.)
Actual Size - 814" length
\$8.50



Permacel Electrical Tape

¾" (wide) X 66 ft. (long) . All weather . Not import \$1.25 per roll — \$9.95 per 10 roll package

	ZENE	RS -	DIODE	S —	RECTI	FIERS	
TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	53	400 mm	4/1 05	194005	500 PA	1 AMP	10/1 00
1N751A	5.5	400m	4.1 00	154000	800 PG	1 AMP	10/1 00
1N752	5.6	400m	4/1 00	194007	1000 FN	1 AMP	10/1 00
1N753	6.2	400m	4/1 00	1W3500	50	200m	8/1 00
1N754	6.3	400m	4/1 00	194148	75	10m	15/1 00
1N959	6.2	400m	8/1 00	194154	35	10m	12/1 00
1N965B	15	400m	471.00	19/4305	75	25m	20/1 00
1N5232	5.6	500m	26	194734	5.6	1 Wr	28
1N5234	6.2	500m	79	189738	5.2	1w	28
1N5235	6.1	506m	28	194736	58	1w	28
1N5236	1.5	500m	26	164738	8.7	1w	28
1N456	25	40m	6/1.00	inere:	12	1w	28
1N458	150	700	6/1 DO	184744	15	1w	28
1N4B5A	180	1 Drn	6/1.06	1N11E3	55. PW	35 AMP	1.80
1N4001	50 PSF	1 AMP	12/1 50	181188	100 PW	35 AMP	1 70
1N4002	100 PW	1 AMP	12/1.00	181185	156 PW	35 AMP	1.50
1N4003	200 PW	1 AMP	12/1 00	INTER	200 PW	35 AMP	1.80
1N40D4	400 PW	1 AMP	12/1 06	INTER	ATRI PIN	35 AMP	3.00

900	AND EW DD	IDGE RECTIFIERS	
C360	15A @ 400V	SCR THE THE TENE	\$1.95
C38M	35A @ 200V	SCR	1 95
2N2328	1.6A @ 200V	SCR	50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1 95
	7041	CICTORC THOU	4/61.00

MPS A05	5/\$1.00	TRANS	STORS	PN4249 PN4250	4/51 00 4/51 00
MPS AD6	5/\$1 00	PARKET	343.00	294400	4/S1 00
2N2219A	3/\$1.00	64.76.44	25170	2944601	4/\$1 00
2N2221	4/21 00	P 420 POST	4.67.307	2914407	4/\$1.00
2N2222A	5/\$1 BC	PN3589	431 (6)		
2N2369	5/\$1 00	275.675	22110	2N4403	4/\$1 00
2N2369A	4/\$1.00	75330	33130	2164-609	5:\$1 00
		79(1706	555 10	295085	4/51 00
2N2484	4/\$1 00	250001	N 81 HO	29(5087	4/S1 D0
2N2906A	4/S1 00	787711	45170	2N5688	4/\$1.00
2N2907A	5/\$1.00	200	2 60	29/5089	4/\$1 00
2N2925	5/\$1.00	200	8 90		
2N3053	251 00	38435	\$1.00	285129	5/\$1 00
2N3055	S 89	25/1907	5 \$1 (8)	2N5138	5/\$1 00
	\$1 00	25/1907	48110	2945139	5/\$1 00
MJE3055		75,000	430.00	2%5209	5%1 00
MJE2955	\$1 25	1 A 1990m	451 (0)	2N5951	5/\$1 00
2N3392	5/\$1 00	76470	2.85.00	C106819C8	251 00
2N3398	5/\$1 00	194115	3.25 10	2N5432	\$2 00

2N3392 2N3398	5/\$1 00 5/\$1 00		29400 294015 294115	35 10 35 10 15 51 10	0	1068190 N5432	SP 251 00 SP 00
CAP	ACITO	R		T CERAMIC		COF	RNER
				PACITORS			
	1-9		9 50-10		1-9		9 50-100
10 pf	.05	04	03	001μF	05	.04	.035
22 pt	.05	04	03	0047µF	05	.04	.035
47 pf	.05	04	.03	01µF	05	.04	.035
100 pf	.05	04	.03	022µF	06	.05	04
220 pf	.05	04	03	047µF	06	.05	.04
470 pf	05	.04	035	1μF	12	.09	075
				FILM CAPACE			
.001mf	.12	10	.07	.022mf	13	11	08
.0022	12	10	07	047mf	.21	17	.13
.0047mf		10	07	1mf	.27	23	.17
.01m1	.12	10	07	22mf	33	27	.22
	+20%	DIPPED	TANTAL	UMS (SOLID) C	APACIT	DRS	
.1/359	.28	23	.17	1.5/35V	30	26	.21
.15/35	V .28	.23	17	2.2/25V	.31	.27	.22
.22/35	V .28	23	17	3.3/25V	31	27	.22
.33/35	V .28	23	17	4.7/25V	.32	28	.23
.47/35	¥ .28	23	17	6.6/25V	36	.31	.25
68/35		23	.17	10/25V	.40	35	.29
1.0/35V		.23	17	15/25V	.63	.50	.40
	MINIATE	RE ALL	MINUM	ELECTROLYTIC	CAPACI	TORS	
	Axiat I	ead			Radial	Lead	
.47	/50V .15	13	.10	.47/25V	15	13	. 10
1.0/		.14	.11	.47/50V	16	14	.11
3.3/		13	.10	1.0/16V	15	13	.10
4 7/		.14	.12	1.0/25V	.15	.14	.11
10/25		13	-10	1.0/50V	.16	.14	.11
10/50		14	.12	4.7/16V	15	.13	.10
22/25		.15	.12	4.7/25V	15	.13	.10
22/50		.20	.18	4.7/50V	16	14	.11
47/25		.17	.15	10/16V	14	.12	.09
47/50		.21	.19	10/25V	15	13	.10
100/25		.20	18	10/50V	15	.14	.12
100/50		30	.28	47/50V	.24	21	.19
220/25		.28	.25	100/16V	19	15	.14
220/50		.41	.38	100/25V	.24	.20	.18
220/30	.43	.41	.50				. 10

29 50 62 .27 .45 100/50V 220/16V 470/25V

95 RC4195

T 1/4LS19

149 74LS19

149 74LS19

141 74LS

39 (**L0130** 603 (**A1586**)

5 Dogt 8CD Gutputs Reset PIN 8 Dogt 8CD Gutputs 12 or 24 Hour 4 Orga 8CD Gutputs 19 PS Gutput 5 Dogt 1, 20 or 24 Hour 4 Orga 8CD Gutputs 19 PS Gutput 6 Dogt 1, 20 or 24 Hour 4 Orga 14 Hour 50 or 60 Hz 4 Orga 14 Hour 50 or 60 Hz 1 Orga 14 Hour 50 orga 14 Hour

DATA HANDBOOKS
n out & Description of 5400/7400 ICS \$2.95
n out & Description of 4000 Series ICS \$2.95
n out & Functional Description \$2.95
ALL THREE HANDBOOKS \$6.95

74LS00

TUBES

RADIO & T.V. Tubes-36 cents each. Send for free Catalog, Cornell, 4213 University, San Diego, Calif. 92105. TUBES receiving, factory boxed, low prices, free price list Transleteronic, Inc., 1365-39th Street, Brooklyn, N.Y. 11218A, Telephone: 212-633-2800.

TUBES: "Oldies", Latest. Supplies, components, schematics, Catalog Free (stamp appreciated), Steinmetz, 7519-PE Maplewood, Hammond, Ind. 46324.

RECEIVING TUBES. National Brands. Up to 80% discount. National Audio. 2500 Channing Road. Cleveland. Ohio

TAPE AND RECORDERS

RENT 4-Track open reel tapes-free brochure. Stereo-Parti, P.O. Box 7, Fulton, CA 95401.

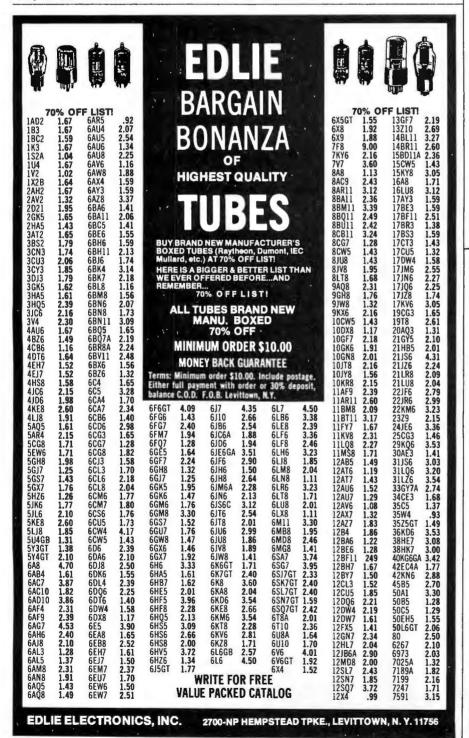
WE WILL BEAT any price sheet in America. Featuring TDK, MAXELL, and others. Tape World International. 220 Spring St., Butler, PA 16001.

BASF TAPE: We carry only BASF so our prices are the lowest! All tapes new and GUARANTEED. Enclose this ad with any order and we'll pay shipping (USA only). INTERGALACTIC ENTERPRISES, 1043 Kirts, Troy, Michigan 48084.

BLANK TAPE BONANZA, TDK: 10 SA-C90 \$30.85, 10 SA-C60 \$21.85. MAXELL: 12 UDC-90 \$35.31. 10 UD35-90 \$49.99. 12 UDXL-C90 (Lor II) \$41.43. All prices include shipping. (PA add 6% sales tax). Give us a try! Tape World International, 220 Spring St., Butler PA 16001

DO-IT-YOURSELF

MODULAR TELEPHONES now available. Sets and components, compatible with Western Electric concept. Catalog 50 cents. Box 1147W, San Diego, California 92112. NEGATIVE ion generator, Construction plans \$7.50. Complete kit \$165.00. Golden Enterprises, Box 1282PE. Glendale, Arizona 85311.



=ABOUT YOUR= SUBSCRIPTION

Your subscription to POPULAR ELECTRONICS is maintained on one of the world's most modern, efficient computer systems, and if you're like 99% of our subscribers, you'll never have any reason to complain about your subscription service.

We have found that when complaints do arise, the majority of them occur because people have written their names or addresses differently at different times. For example, if at different times. For example, if your subscription were listed under "William Jones, Cedar Lane, Middletown, Arizona," and you were to renew it as "Bill Jones, Cedar Lane, Middletown, Arizona," our computer would think that two separate subscriptions were involved and it scriptions were involved, and it would start sending you two copies of Popular Electronics each month. Other examples of combinations of names that would confuse the computer would include: John Henry Smith and Henry Smith; and Mrs. Joseph Jones and Mary Jones. Minor differences in addresses can also lead to difficulties. For example, to the computer, 100 Second St. is not the same as 100 2nd St.

So, please, when you write us about your subscription, be sure to enclose the mailing label from the cover of the magazine—or else copy our name and address exactly as they appear on the mailing label. This will greatly reduce any chance of error, and we will be able to service your request much more quickly.

Popular Electronics

Hundreds of references to subjects, products, and technical tips that you know are in the magazine but can never find when you want them - all arranged for fast, easy reference.

Prepared in cooperation with the magazine editors, each of these handy indexes covers a full year of 12 issues and is an indispensable companion to your magazine collection.

1976 Edition

each plus 25 cents per copy for postage handling (50 and cents for foreign orders).

Back index editions also still available from 1972 onwards. When ordering, mention magazine title and specify volume years desired. Please be sure to include correct postage - avoid having your order returned.

POPULAR ELECTRONICS INDEX Box 2228, Falls Church, Va., 22042

S.D. SALES CO.

P. O. BOX 28810 - D DALLAS, TEXAS 75228

JUMBO LED CAR CLOCK

\$16.95

KIT

Alarm Option - \$1.50 AC XFMR - \$1.50

THE HOTTEST SELLING KIT WE EVER PRODUCED!

You requested it! Our first D.C. operated clock kit. Professionally engineered from scratch. Not a makeshift kluge as sold by others. Features:

A. Bowmar Jumbo -.5 inch LED array.

B. MOSTEK - 50250 - Super Clock Chip.

C. On board precision crystal time base.

D. 12 or 24 Hr. Real Time Format.

E. Perfect for cars, boats, vans, etc.

F. P.C. Board and all parts (less case) included.

50,000 SATISFIED CLOCK KIT CUSTOMERS CANNOT

THIS MONTH'S SPECIALS

AMD - 8080A \$14.95 Z-80 CPU 49.95 82S129 1K PROM

1702A 2K EPROM

We tell it like it is. We could have said these were factory new, but here is the straight scoop. We bought a load of new computer gear that contained a quantity of 1702 A's in sockets. We carefully removed the parts, verified their quality, and are offering them on one heck of a deal. First come, first served. Satisfaction guaranteed!

U.V. Eraseable. \$6.95 ea. 4/\$25 \$6.95 ea.

UP YOUR COMPUTER! 21L02-1 1K LOW POWER 500 NS

STATIC RAM Time is of the essence! And so is power. Not only are our RAM's faster than a speeding bullet but they are now very low power. We are pleased to offer prime new 21L02 1 low power and super fast RAM's. Allows you to STRETCH your power supply farther and at the same time keep the wait light off. 8 for \$12.95

60 HZ CRYSTAL TIME BASE S.D. SALES EXCLUSIVE! \$5.95

KIT FEATURES:

- A. 60HZ output with accuracy comparable to a digital
- Directly interfaces with all MOS Clock Chips.
- Super low power consumption (1.5 ma typ.)
- Uses latest MOS 17 stage divider IC.
- E. Eliminates forever the problem of AC line glitches.
- Perfect for cars, boats, campers, or even for portable clocks at ham filed days. 2/\$10.00
- Small size; can be used in existing enclosures. Kit includes Crystal, Divider IC, PC Board, Plus all necessary At last count - over 20,000 sold!

EN2222 NPN

EN2907 PNP

2N3904 NPN

2N4400 NPN

2N4402 PNP

1000 MFD Tilter Caps
Rated 35 WVDC
Upright style
with PC leads.
Most popular
value for hobbyists. Compare at
up to \$1.19 ea.
from franchise
type electronic
parts stores, S.D.
Special 4/\$1. parts ... Special

TRANSISTOR SPECIALS

8 for \$1.00

8 for \$1.00

8 for \$1.00

10 for \$1.00

8 for \$1.00

Slide Switch Assortment

Assortment
Our best seller.
Includes miniature and standard sizes; single and multi-postion units. All new, first name brand. Try one package and you'll reorder more! Special 12/\$1.00

12/\$1.00

RESISTOR ASSORTMENT 1/4W 5% & 10% PC leads. A good mix of values. 200/\$2.

S.D. SALES EXCLUSIVE

\$12.95 MOS 6 DIGIT UP—DOWN COUNTER \$12.95
40 PIN DIP. Everything you ever wanted in a counter chip.
Features: Direct LED segment drive, single power supply (12
VDC TYPE.), six decades up/down, pre-loadable counter,
separate pre-loadable compare register with compare output, BCD and seven segment outputs, internal scan oscillator, CMOS compatible, leading zero blanking. 1MHZ. count
input frequency. Very limited quantity! WITH DATA SHEET

7400—19c 7411—29c 7451—19c
74LS00—49c 7413—50c 7453—19c
74LS02—19c 7416—69c 7473—39c
74LS02—49c 7420—19c 7474—35c
7404—19c 7430—19c 74LS74-59c
74504—44c 7437—39c 7476—69c
74504—49c 7438—39c 7476—69c
74504—49c 7438—39c 7486—95c
7408—19c 7447—85c 7485—95c
7408—19c 7448—85c 7486—45c
TTL INTEGRATED CIRCUITS 7490-65c 74153-75c
74L590-95c 74154-1.00
7492-75c 74154-75c
7493-69c 74161-95c
7495-75c 74164-1.10
7496-89c 74165-1.10
74121-38c 74174-95c
74123-65c 74181-2.50
74132-1.70 74191-1.25 74164-1.10 74165-1.10 74174-95c 74181-2.50 74191-1.25 74192-1.25 74193-1.00 74195-69c

P.C. LEAD

DIODES 1N4148/1N914 100/\$2.00 1N4002-1A. 100 PIV 40/\$1.

HEAVY DUTY Full Wave Bridge 25 AMP 50 PIV \$1.25

DISC CAP ASSORTMENT PC leads A PC leads. At least 10 different values. Includes 001, 05, plus other standard value. 60/\$1.00

C&K MINI TOGGLE SWITCH No. 7101. S.P.D.T. Panel mount or P.C. mount. 79c Panel 79c

LED's WITH CLIPS
Jumbo Red. RL-2
by Litronix. With plastic mtg.
clips which are very scarce. 3 for \$2. 4 for \$1.00

SIX DIGIT LED ALARM CLOCK KIT

We made a fantastic kit even better. Redésigned to take advantage of the latest advances in I.C. Clock technology. Features:
Litronix Dual ½ inch displays, Mostek 50250 super clock chip, Single I.C. segment driver, SCR ditit drivers. Greatly simplified construction. More reliable and easier to build. Kit includes all necessary parts (except case). P.C.B. or XFMR optional.
ALL NEW DESIGN!

P.C. Board — 3.00

AC XFMR — \$1.50

KIT - \$9.95

Motorola SCR 2N4443. 8 AMP 400 PIV. P.C. Leads 3/\$1.

FAIRCHILD - TBA 641 4W. Audio power Amp. Just out! In special heat sink DIP. One super audio IC. \$1.50 with data

FND-359 -Led Readout .4 IN. Common Cathode. High effeciency. Has FND-70 PIN OUT. 59c

OUR CATALOG is chocked full of rare parts bargains, deals, RAM or CPU kits, plus much more. Yours FREE!

PRICES SHOWN SUBJECT TO CHANGE WITHOUT NOTICE.

\$15.95



COMPUTER POWER SUPPLY A very fortunate purchase. One of the best industrial quality REG-

ULATED supplies we have seen. High performance, small size. Input is 120 VAC 60 HZ. Has the following regulated outputs: -5VDC@800MA; -15VDC @ 1.25 AMP; -25VDC @ 180 MA. Sold at a fraction of original cost. Do yourself a favor and order NOW. We expect a quick sellout.

NEXT MONTH:

S.D. will have music for your ears. Watch our ads.

For your Imsai or Altair 8080 Computer: Z-80 CPU Kit - \$149. 4K Low Power Ram Kit - \$89.95

Terms: Money back guarantee. No COD. Texas residents add 5% sales tax. Add 5% of order for postage & handling. Or-ders under \$10. add 75c. Foreign orders: US funds Call your Bankamericard or Master Charge order in on our United States continental toll free Watts:

1-800-527-3460 Texas Residents Call Collect: 214/271-0022

Special Thanks to: Dennis, Fred, Abe, Bill, Sam, Hal, Tom, Alex, John, Ely, and Larry

S.D. SALES CO. P. O. BOX 28810 Dallas, Texas 75228

INSTRUCTION

LEARN ELECTRONIC ORGAN SERVICING at home all makes including transistor. Experimental kit.—trouble-shooting. Accredited NHSC, Free Booklet. NILES BRYANT SCHOOL, 3631 Stockton, Dept. A, Sacramento, Calif.

SELE-STUDY OB RADIO REPAIR COURSE. THERE'S MONEY TO BE MADE REPAIRING CB RADIOS, This easyto-learn course can prepare you for a career in electronics enabling you to earn as much as \$16.00 an hour in your spare time. For more information write: CB RADIO REPAIR COURSE, Dept. PE057, 531 N. Ann Arbor, Oklahoma City,

LEARN WHILE ASLEEP! HYPNOTIZE! Astonishing details. strange catalog free! Autosuggestion, Box 24-ZD, Olympia. Washington 98507.

UNIVERSITY DEGREES BY MAIL, Bachelors, Masters, Ph.D's ... Free revealing details. Counseling, Box 317-PE5, Tustin, California 92680. INTENSIVE 5 week course for Broadcast Engineers. FCC First Class license. Student rooms at the school. Radio Engineering Inc., 61 N. Pineapple Ave., Sarasota, FL 33577 and 2402 Tidewater Trail, Fredericksburg, VA 22401.

PRACTICAL Electronic Training, FCC license, Free home study catalog. Genn Tech.. 5540 Hollywood Blvd., Los Angeles, CA 90028. Or, Ra-Tel Electronics, P.O. Box 167, Toronto, Ont., Canada, U.S. Inquiries,

LEARN BASIC Digital Troubleshooting by correspondence. Course includes text and demonstration modules. Educational Technologies, Box 224, Reynoldsburg. Ohio 43068

CB'ERS-Be a "Ham"-We'll teach you! Life Membership: \$4.00. American Radio Council, Box 1171-K. Garland. Texas 75040

HIGHLY EFFECTIVE Degree Program in Electronics En, gineering. Advance rapidly! Our 31st Year, Free literature. Cook's Institute, Box 20345, Jackson, Miss. 39209.

BURGLAR/FIRE EXPERTS NEEDED for cars, homes, industry. Learn high profit systems installation at home spare time. Simple, quick, complete. Free information by mail. No salesmen. Security Systems Management School (homestudy), Dept. 7373-057, Little Falls, N.J. 07424

GET YOUR COMMERCIAL FCC License. New exams by author of successful published workbooks of FCC Practice Tests, 500 Questions Second Class, \$11,95; 200 First Class, \$7.95; 100 Radar, \$4.95; postpaid. Save, all three \$19.95. Complete mathematical solutions. Free counselling service. Victor Veley, P.O. Box 14, La Verne, Calif. 91750. GRANTHAM'S FCC LICENSE STUDY GUIDE - 377 pages,

1465 questions with answers/discussions - covering third, second, first radiotelephone examinations, \$13.45 postpaid. GSE, P.O. Box 25992, Los Angeles, California 90025.



BROADCAST STATION? Operate your own FM, Cable Carrier-Current from home, school, church or as money making business. Free details. "Broadcasting", Box 5516-AE, Walnut Creek, CA 94596.

GO FIRST CLASS! Complete FCC examination questions diagrams - answers, plus "topical study" guide, \$8.95. EGW Publications, Box 5516-AE, Walnut Creek, CA 94596.

SCORE high on F.C.C. Exams... Over 300 questions and answers, Covers 3rd, 2nd, 1st and even Radar, Third and Second Test, \$14.50; First Class Test, \$15.00. All tests, \$26.50, R.E.I., Inc., Box 806, Sarasota, Fla. 33577.

PERSONALS

MAKE FRIENDS WORLDWIDE through international correspondence. Illustrated brochure free. Hermes-Verlag. Box 110660/Z, D-1000 Berlin 11, Germany.

WARTS, Vergo® Cream is painless, safe, easy, gentle. Buy Vergo® at better pharmacies

INVENTIONS WANTED

INVENTORS: Manufacturers Need New Products. Free "Recommended Procedure." by a creative fee-based invention service company. Washington Inventors Service, 422-T Washington Building, Washington, D. C. 20005.



REWARD...OR CRED FOR "INVENTING IT FIRST" MAY BE YOURS!

If you have an idea for a new product, or a way to make an old product better, contact us, "the idea people" We'll develop your idea, introduce it to industry, negotiate for cash sale or royalty licensing. Write now without cost or obligation for free information. Fees are charged only for contracted services. So send for your FREE "Inventor's Kit." It has important Marketing Information, a special "Invention Record Form" and a Directory of 1001 Corporations Seeking New Products.



RAYMOND LEE ORGANIZATION 230 Park Avenue North New York NY 10017

At no cost or obligation, please rush my FREE "Inventor's Kit No. A-112"

Name		
Address		
City	State	Zip
Phone No.	Area Co	ode

MAGNETS

MAGNETS, All types, Specials-20 disc, or 10 bar, or 2 stick or 8 assorted magnets. \$1.00. Magnets, Box 192-H Randallstown, Maryland 21133.

WANTED

GOLD, Silver, Platinum, Mercury wanted. Highest prices paid by refinery. Ores assayed. Free circular, Mercury Terminal, Norwood, MA 02062



\$6.50

CABINET I

3"H,6%"W,5%"D

CABINET II

2½"H,5"W,4"D

NEW LSI TECHNOLOGY

ONLY 8 IC's! . XTAL TIME BASE

truly "State of the Art" counter using quality

COMPONENTS INTOUGHOUL.

KIT INCLUDES: DETAILED INSTRUCTIONS, XTAL,
TOP QUALITY FIBERGLASS DOUBLE SIDED PC
BOARD, IC'S WITH SOCKETS AND ALL PARTS LESS

CABINET WILL HOUSE #FC-50, #PS-02, AND A

DELIVERIES TO START IN MAY, 1977

10:0

components throughout.

POWER SUPPLY AND CABINET.

5 VOLT REGULATED 1 AMP POWER SUPPLY KIT

CABINET [& MTG HARDWARE]

350 MHZ PRESCALER KIT 650 MHZ PRESCALER KIT

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays

Black, White or Clear Cover

#FC-50

#PSL-350

#PSL-650 \$29.95

#PS-02

\$69.95

\$9.95

23.95

\$19.95

XTAL TIME BASE Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC

hook-up info.
Kit # JD-1CC For common Cathodo
Kit # JD-1CA for common Anodo

1"x2"PC Board Power Req: 5-15V (2.5 MA. TYP.) Easy 3 wire hookup Accuracy: ± 2PPM

60 HZ

TB-1 (Adjustable) Complete Kit \$495

RED OR GREY PLEXIGLAS

JUMBO RED

10 FOR \$1 00 100 FOR \$9 50

Ti

MM 5312 \$ 4.95 MM 5314 3.95

MM 5375 AB 3.95

250

VARIABLE REGULATED

1 AMP

POWER SUPPLY KIT

VARIABLE FROM 4 to 14V

SHORT CIRCUIT PROOF 723 IC REGULATOR 2N3055 PASS TRANSISTOR

CURRENT LIMITING AT 1 AME

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND

KIT#PS-01 \$8.95

3"x6"x1/8"

FOR DIGITAL BEZELS

95° ea. 4/*3

25 AMP BRIDGE

\$1.95 ea.

3/\$5.00

100 PIV

1-24 25 100 \$ 25 \$ 22 \$.20 .25 .22 .20 .28 .25 .23 .31 .28 .26 .50 .45 .40 .60 .55 .50 .75 .70 .65

master charge

ALL PARTS (Less TRANS

TRANSFORMER 24V CT will

provide 300MA at 12V and 1 Amp at 5V with #PS-01, \$3.50

FORMER)

SPECTROL 10K 10 TURN

95c

FREQUENCY COUNTER KIT 8 LARGE .4" RED LED DIGITS

Wir & Cal \$9.95

SET OF 6 FND 359 WITH MULTIPLEX PC BOARD Fairchild Super Digit

FND-359 .4" Char. Ht. 7 segment LED RED Com. Cath. Direct pin replacement for replacement for

MOLEX

95¢ ea, 10/\$8.50 100/\$79.00

NYLON WIRE TIES 8" TIE-WRAP 100/\$1.95 4" TIE-WRAP 100/\$1.75 IC SOCKETS

PINS orm Inexpensive 100 for \$1.25

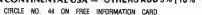
Reel of 1000 - \$8 Orders Under \$15 Add \$1.00 Handling Fla. Res. Please Add 4% Sales Tax.

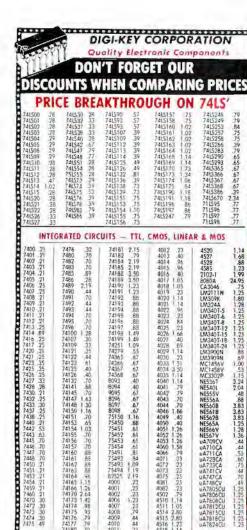
ORDER BY PHONE OR MAIL COD ORDERS WELCOME

optoelectronics, inc.

BOX 219 . HOLLYWOOD, FLA. 33022 . (305) 921-2056











\$2.00	500 58	50 10	00, 212,00
5	ILICON	DIODES	
001 002 003 004 005 006 007	.64/10 .66/10 .68/10 .70/10 .82/10 .90/10 .99/10 .48/10	5.50.C 5.60.C 5.80.C 5.75.C 7.75.C 7.75.C 6.50.C	\$49 M 551 M 352 M 854 M 563 M 569 M 377 M 829 M

Sove You Even Morel

1 N4 1 N4 1 N4 1 N4 1 N4 1 N4 1 N4

1/2	WAT	ZENER	DIODE	S
	5 3v 15		36B 7 5v 15	
1N52288	190 IS	11 C 1N57	388 # 7+ 15 398 # 1+ 15	211 C
1N5230B	474 15 514 15	111 C 1852	405 10v 15	\$11/6
	5.6v 15		42B 12v 15	

SIGNETICS ANALOG MANUAL ... \$5.95

PLESSEY SAMPLER

300 Copt 18 Values \$26.00

NSL5056 3-11-0

LED .18 S15/C

************************************ LED DUAL DIGITS

PRICED PER PAIR OF 2 DIGITS

NSN373 0.3" CC . \$2.70/Pair NSN373 0.3" CA . \$2.20/Pair NSN384 0.5" CC . \$2.60/Pair NSN584 0.5" CA . \$2.60/Pair NSN584 0.5" CC . \$2.60/Pair NSN784 0.7" CA . \$3.00/Pair







MA1003 CAR CLOCK

12 Hour Only 12 Volt DC Crystal Time Base Bright Green Digits Assembled and Tested

NEW - FOR CAR OR BOAT

The MA1003 bright green flourescendisplay offers a brilliance that cannobe achieved by LED displays, a feature that sold Detroit!



MA1002 0.5" High Digits



MA 1002A	12 How AM PM	1111	510.50
MA1002C	24 Hour	00000	\$10.50
SPECIAL T	RANSFORMER & SW	ITCHES	\$3.45

ABOUT

.18 515/0

The MATRIX and MACOID NATION 15-X maked the are four intermibles and support 15-31 and 150 and

ı	MA1002A SET Modern and Fronteman & Security	513.95
	MA1002C & HD 24 Hair Disco Macur	510.5
	MA1002C SET Make a m Jegeth mor & honeful	513.95
	MATORS 17 VALLED THE MICH SPECIMEN	524.95
	MATOTOA THE HED TO HOW AMERY TO THE MANUAL	\$13.00
	MATOTOA SET Magail were Thoughtones & Land Nate	\$16.45
	MA1010C of HD 24 Harr Chris Nadare	\$13.00
	MA1010C SET Middle and Franciscon & Seatther	\$16.45

MA1002A 5 HE 17 Hair AND FULL MALE \$10.50

MATURIZA SET Modern and Transferment & Imperior	213.4
MA1002C & HD 24 Hair Disco Macur	510.5
MA1002C SET Motors and Ingestiment & Sanction	513.9
MA1003 17 vali for Elect with Surgician	524.9
MATOTOA THE HED IS HOW AND PURPLE VANDO	\$13.0
MATOTOA SET Prograb were Thoughtoning & Captings.	\$16.4
MA1010C of 150 33 Harr Clark Madare	\$13.0
MA1010C SET Middle and Frencherer & hearther	516.4

RADIAL ELECTROLYTICS 27/50V 100/6/3V 100/10V 100/16V 100/50V 220/16V 220/16V 220/25V 220/25V 220/25V 230/10V 330/16V 100 10 11 13 15 21 21 15 21 330/25V 23 470/10R 21 470/16V 23 470/25V 29 1000/16V 29 1000/16V 29 1000/75V 42 7200/16V 42 7200/16V 54 2200/25V 58 3300/16V 89 65/10 65/10 65/10 65/10 65/10 75/10 67/10

100		XIAL ELECT	ROLYT	CS	
47/10V 11 1/30V 12 2.3/50V 12 2.3/50V 12 4.7/55V 12 4.7/50V 12 10/50V 18 22/16V 12 22/16V 12 22/16V 17 33/16V 12	90 10 90 10 95 10 1.00 10 95 10 1.00 10 1.00 10 1.00 10 1.00 10 1.00 10 1.00 10 1.00 10 1.00 10 1.00 10	33/25V 14 33/55V 19 47/16V 19 47/25V 17 47/55V 21 100/10V 14 100/16V 17 100/25V 29 220/16V 12 220/25V 29 220/25V 29 220/30V 16	1.15/10 1.52/10 1.15/10 1.30/10 1.17/10 1.13/10 1.30/10 1.35/10 2.30/10 1.42/10 1.42/10 1.55/10 2.35/10 3.23/10	330/16V 29 330/75V 32 470/16V 37 170/16V 37 1000/10V 33 1000/16V 33 1000/25V 56 2200/16V 62 2200/25V 74 3300/16V 99 1700/16V 10 4700/16V 10 10000/16V 10 10000/16V 10 10000/16V 10 10000/16V 11 10000/16V 11	2.35/10 2.55/10 2.55/10 3.00/10 3.15/10 4.50/10 4.95/10 6.36/10 7.63/10 9.19/10

Double Digit Discounts Save You Even Morel



77 of 47 of of .	50 10 4 00 C 70 10 5 40 C 1 35 10 11 50 C	DIGI-KEY CORPORATION Box 677. Thirf River Folis. MN 56701 218-681-6674
	77 uf	27 uf 50 10 400 C 47 uf 70 10 5 40 C uf 135 10 11 50 C

Actual size: 1.75"x3.75"

SEND FOR OUR FREE CATALOG

Linear IC	3 955 pt		\$5,00
CM05 74	C 256 p		23.00
Wemary	4C % 542	ä	\$7.00
Interface			\$4.00
Valt. Rec	11. 178 p		33,00
Linear A	00 1 43	7.0	54.00
Linear Ag			\$3.00
Audio 19	6 p		. \$3.00
M05/L51	IC's 713	9	\$4.00
GM05 40	CO 278 p		53.25
Analog N	Namual &	7 p	19.95
51	IDE S	WITCH	15
3P57.	(5	(20/10	10.00/E
SPDT	10	70/10	13 00 C

DATA BOOKS

DPDT	23 2.00/10 19.00/C
STRAND	ED HOOK UP WIRE
20 ga PVC	2.50/100* 10.00/500 2.80/100* 11.25/500
	2.10/100 F 50/500
26 go PV€	2.10/100 15.50/50(1)
50	VOLT DISCS
100 pt.	40 10 3 50 C

	50 VOLT	D	ı	50	5	
- 1	100 of:	41	a	19	3	50
- 1	720 of	40	Q	16	3	50
- 1	470 of	40	0	10	2	50%
	001 af	40	0	10	3	50)
н	0022 of	4	Ċ.	10	3	50
ш	0047 Uf					50
п	01 uf	4	ç	10	3	6-9
-1	022 of	51	Ŋ	10	4	00
-	947 uf .					101
1	(1 of)	3	5	10	11	50

WIRE-WRAPPING TOOL \$5.95 Wraps, Unwraps & Strips 30 ga. Wire

% & 1/2 WATT 5% CARBON FILM RESISTORS

5c each in multiples of 5 per value \$1.70/100 & \$17.00/1000 of some value 1 ahm thru 1.0 megahm

BLE-DIGIT DISCOUNT SCHEDULE INT. Basepy: Merchandlin Discount 1/10/10/10/10/10/10/10/10/10/10/10/10/10	S	18 Pin	Solder Solder Solder Solder Solder W.W W.W W.W W.W W.W W.W	27 29 20 36 45 45 45 24 26 26 26 26 26 26 26 26 26 26 26 26 26	1,90,10 2,10,10 2,75,10 3,60,10 1,25,10 1,00,10 2,50,10 2,50,10 2,50,10 2,50,10 1,10,10 1,00,10 1,75,10	***************************************
4 99 ald 17 Do 1 50 00 197 99 add 50 25 4 99 ald 50 75 \$100 00 & a. No Decrys		-				
4 99 ald 17 Do 1 50 00 197 99 add 50 25 4 99 ald 50 75 \$100 00 & a. No Decrys	4,99 1	441	\$100 00-10 \$500 pt-1	NO 00	A1 155	Ä
4 99 ald 17 Do 1 50 00 197 99 add 50 25 4 99 ald 50 75 \$100 00 & a. No Decrys						8
4 99 ald 17 Do 1 50 00 197 99 add 50 25 4 99 ald 50 75 \$100 00 & a. No Decrys	DARD	SHIPPING	/HANDL	ING CI	HARGE	В
4 99 and \$0.75 \$100.00 A as No Charge C	mercha	milia total	mitter der	aant is !	in Panes	В
	4.99	att \$0.75				i
des phipping and incurance to USA & Commits	des ships	ing and in	turnisco he	054 L	Constitution	R

I.C. SOCKETS

CALCALIST CONTRACTOR OF THE PERSON AND PERSO

HARDWARE	DOUBLE-DIGIT DISCOUNT SCHEDULE				
6 1/4 Strew 99/C 7.20/M 6 1/2 Strew 99/C 7.65/M 0 1/4 Strew 55/C 3.60/M 0 1/2 Strew 60/C 4.05/M	Merikandise Disposet Marchandise Disposet 1/0/10/24/99 Dest 155 1/0/10/24/99 Dest 155 Disposet Dispos				
2 1/4 Strew 65/C 4.40/M 2 1/2 Strew 75/C 4.85/M	Then Add the Standard Charge Balow				

STANDARD SHIPPING/HANDLING CHARGE

COD ORDERS ACCEPTED FOR SAME DAY SHIPMENT - CALL 218-551-6674

Only Quality Components Sold!"



EMPLOYMENT OPPORTUNITIES

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUN-ITIES. Report on jobs now open. Details FREE, Aviation Employment Information Service, Box 240E, Northport, New York 11768

OVERSEAS JOBS - NOW HIRING! High Pay! All Occupations. Transportation. Computerized Reports — \$2.00. TRANSWORLD, International Airport, Box 90802-N, Los Angeles, Calif. 90009.

HYPNOTISM

SLEEP learning, Hypnotic method, 92% effective, Details free. ASR Foundation, Box 23429EG, Fort Lauderdale, Florida 33307

FREE Hypnotism. Self-Hypnosis. Sleep Learning Catalog! Drawer H400, Ruidoso, New Mexico 88345.

AMAZING self-hypnosis record releases fantastic mental power. Instant results! Free trial. Write: Forum (AA5), 333 North Michigan, Chicago 60601.

TREASURE FINDERS

TREASURE may lie beneath your feet! Discover gold, silver, coins, rings, artifacts and more with world-famous deeper-detecting White's metal detectors. From \$59.95. Dealers world-wide Free literature! White's Electronics Dept. PD7-C, 1011 Pleasant Valley Rd., Sweet Home, OR

REAL ESTATE

BIG...NEW., FREE...SUMMER 1977 CATALOG! Over 2,600 top values coast to coast! UNITED FARM AGENCY, 612-EP, West 47th, Kansas City, MO 64112.

RUBBER STAMPS

RUBBER STAMPS, BUSINESS CARDS, Many new products, Catalog, Jackson's, Dept. K. Brownsville Rd., Mt. Vernon, III, 62864

INTERNATIONAL ELEC TRONICS UNLIMITED

\$9.95 \$3.95

\$1.79

9 MAN 3 M

ON PC BOARD

99 :

99 :

2.49

1.98

2.95

3.95

3.95

8 7 2.8

\$2.35 \$1.50

CALC, KIT ONLY

ADAPTER -60Hz

MM5369 Divider mDIP Crystal 3.58 MHZ color TV

CALCULATOR

nung

CALCULATOR CHIPS
CT5002 12 digit, 4 function fixed decimal

18 pin MM5736 6 digit, 4 function, 9V battery

operation - 22 pin

battery operation — 40 pin
CT5005 12 digit, 4 function plus memory, fixed
decimal — 20 pin
MM5725 8 digit, 4 function, floating decimal

operation — 18 pin

MM5738 8 digit, 5 function plus memory and
constant floating decimal. 9V battery
operation — 24 pin

MM5739 9 digit, 4 function, 9V battery

DIFFERENTIAL VIDEO \$.59

DVM CHIP 41/2 DIGIT -

IC BREADBOARD
Accommodates 5 16 pin IC's with addit

holes. 1/16" phenolic with silver rcults. 2 5/16" z 6 9/16" 81.60 as

P channel device provides all logic for 4½ digit volt meter. 16 pin DIP with data.

DISPLAY

KEYBOARD

2 SLIDE SW

MM5330

10% OFF WITH \$25 ORDER 15% OFF WITH \$100 ORDER

THESE DISCOUNTS APPLY TO TOTAL OF ORDER - SPECIALS INCLUDED

TTL					
7400	.13	7451	.17	74153	.89
7401	.16	7453	.17	74154	1,20
7402	.15	7454	.17	74155	.97
7403	.15	7460	.17	74156	.97
7404	.16	7464	.35	74157	.99
7405	.19	7465	.35	74158	1.79
7406	.20	7470	.30	741b0	1.23
7 407	28	7472	.30	74161	.97
7408	.18	7473	.35	74162	1.39
7409	.19	7474	.28	74163	1.09
7410	.16	7475	.49	74164	.99
7411	.25	7476	.30	74165	.99
7413	.43	7483	.68	74166	1,25
7414	.65	7485	.88	74170	2.10
7416	.35	7486	.40	74173	1.49
7417	.35	7489	2.25	74174	1.23
7420	.16	7490	.43	74175	.97
7422	.30	7491	.75	74176	.89
7423	.29	7492	.48	74171	.84
7425	.27	7493	.48	74180	.90
7426	.26	7494	.78	74181	2.45
7427	.29	7495	.79	74182	.79
7430	.20	7496	.79	74184	1.90
7432	.23	74100	.98	74185	2.20
7437	.25	74105	.44	74187	5.75
7438	.25	74107	.37	74190	1.15
7440	.15	74121	.38	74191	1.25
7441	.89	74122	.38	74192	.95
7442	.59	74123	.65	74193	.85
7443	.73	74125	.54	74194	1.25
7444	.73	74126	.58	74195	.74
7445	.73	74132	.89	74916	1.25
7446	.61	74141	1.64	74197	.73
7447	.79	74145	1.04	74148	1.73
*448	.79	74150	.97	74199	1.69
7450	. 17	74151	.79	74200	5.45

GAME CHIP AY-3-8500-1

Six games with scoring

\$24.95 and sound

Mark I Clock Kit

OPTO ISOLATORS

MATER 1 GLOCK NIX A six digit clock kit with one double sided P.C. board accommodates MM5314 clock chip and 6 FND359 .375" displays, 12-24 hour, 50-60 Hz. Contains all necessary components. 3 switches and complete ascembly instructions with schematics. Connections for remote displays.

\$13.95

WILL D	2 Opto isolator blode	1.07
MCT	2 Opto isolator transistor	.70
SPECI	AL DEVICES	
372	AF-IF Strip Detector DIP	2.93
546	AM Radio Receiver Subsystem DIP	.75
1310	FM Stereo Oemodulator DIP	2.90
1496	Balanced Modulator-Demodulator	.99
1800	Stereo multiplexer DIP	2.48
ULN2206	FM Gain Block 34db (typ) mDIP	1.18
ULN2205	FM Gain Block 48db (typ) mDIP	1.35
2513	Character Generator 64x8x5 DIP-24	10.20

Transistor Array DIP-14

REGISTE	R		
LED DISPL	AYS		
MAN 1	1.95	DL33B	.45
MAN 2	3.95	DL33-	.35
MAN 5	2.25	DE00-	.00
MAN 7	1.49	DISCRETE	LED'S
MANS	2.25	ME 4	.29
MAN 66	2.25	MV10B	.25
MAN 72	1.25	MV50	.12
MAN 3620	1.50	NSL100	.12
FND 359	.95		
FND 500	1.89	MV5020	
FND 507	.95	RED	.15
DL10A	2.19	CLEAR	.15

CALCULATOR KIT

TULL ACCUMULATING MEMORY — * KEY

N KEY —

NET —

OWS SEC...
CIMAL POINT KEY;
UMRE ROOT
FERRMS SQUARE ROOT BY PRESSING — THMETIC LOGIC

TO SOU DESTREMENTATION ADDITION AND THE STATE OF THE SOUTH AND THE SOUTH ADDITION ADDI

CENTRAL PROCESSING UNIT 8008 \$19.95 8080A \$19.95

1702A 2048 bit static PROM elect. prog. UV ears. 24 pin

\$6.95

2102 1024 bit static RAM 16 pin \$1.49

LINE	AR CIRC	CUITS			
100	\$.71	373	2.42	723	.62
301	.29	\$76	.68	733	.89
30.2	.33	180	1.30	719	1.07
304	.80	180-8	1.25	741	.32
305	.71	181	1.75	747	.71
107	.26	382	1.75	748	.35
308	.89	531	2.95	1458	.62
10914	1.35	540	295	1800	2.48
110	1.07	550	.79	3900	.49
311	.95	555	45	7524	.71
319	1.13	556A	1.19	7525	.90
1201	1.39	560	3.39	80 38	4.25
120k	1, 39	562	3.39	8864	2,25
122	1.70	565	1.16	75150	1.75
324	1.52	566	1.95	75451	.35
139	1.58	567	1.95	75452	.35
140k	1.69	709	.26	75453	.35
1407	1.49	710	.35	75491	.71
372	2.93	711	.26	75492	.80

CMOS					
4000 A	,26	4018A	1, 19	4066 A	.89
4001A	.25	4020 A	1.72	4068A	.44
4002A	.25	4021A	1.18	4069A	.44
4006A	1.35	4022A	.94	4071A	.26
40C7.A	.26	4023A	.25	4072A	.35
4008A	1.52	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027 A	.59	4078A	.39
4011A	.29	4028A	.98	A\$804	.35
4012A	.25	40 30 A	.44	4518A	1.56
40 tal A	.45	4035A	1,27	4528A	1.56
4014A	1.27	4040A	1.19	4585A	2, 10
4015A	1.27	4042A	1.47		
4016A	.48	4049 A	.59		
4017 A	1.01	40504	59		

IC SOCKETS profile \$.17 .22

FREE CATALOG AVAILABLE ON REQUEST

Satisfaction guaranteed. Shipment will be made postage prepaid within 3 days from receipt of order. Payment may be made with personal check, charge card (include number and exp. date), or money order. Phone Orders—BofA and M/C card or C.O.D.

Add \$1.00 to cover shipping and handling if order is less than \$10.00. California residents add safes lax. Include shipping expense for orders shipped out of U.S. and Canada approx. 10% of order.

INTERNATIONAL ELECTRONICS UNLIMITED **VILLAGE SQUARE, P.O. BOX 449**



CARMEL VALLEY, CA 93924 USA PHONE (408) 659-3171

10000	ELECTRONIC
10	PARTS AND
Ob	ACCESSORIES

ALL-580

AUTO RADIO Pushbutton AM

ACTIVATED SWITCH

XM-556

Activates devices such as lights, tape recorders etc Comes with 5" leads. 3 x 1". Operates on 4.5 VDC. Shpg. wt. 1/2 lb.

Reg.	Sale	
60 Min. Cassette, Pkg. of 3, TA-879 1.49	.87	
2V. RED L.E.D., Pkg. of 5, PL-233 1.99	.59	
40 Min. 8-Track Tape, TA-907	.39	
Elect. Cap. Kit, 50 Asst., CD-407 5.09	1.70	
Black Light Bulb, XM-291 1.00	.49	
CB Converter for Car, CB-417 14.99	9.99	
Resistors 1/2-1 watt, Pkg. 100, RR-077 . 1.79	.79	
Volume Controls, 12 Asstd. VC-274 1.00	.49	
Empire 999 Mag. Phono Cart. PC-188 9.99	6.99	
3-6V DC Hobby Motors, 5 Asstd. MO-333 2.00	.59	
Solder Terminal Strips, 40 Asstd. XM-501 1.30	.50	
Double Face Foam Tape 3/4"x52", TA-903 1.00	.80	
1/4 RPM Timing Motor, 117 VAC, MO-277 49	.30	
8 RPM Revers. Motor 117 VAC, MO-393 . 2.50	.99	
Ceramic Disc Cap., 100 Asstd. CC-210 . 1.29	.80	
Knob Kit, 25 Pcs. Asstd., KN-030 1.00	.69	
8-Track Tape Deck Chassis, RA-383 . 17.00	12.99	
7 Seg. L.E.D. Display Com. K., XM-414 . 2.00	1.00	
Stepping Relay, 6-12 VDC,		
10 Pos., SW-843 5.00	3.00	
2SB474 TO'66 Output Trans., TR-147 3.79	1.19	
Fairchild 703 Type IC, TR-293	.39	
Fairchild 717 Type Linear AM PIC, TR-294	.39	
IC Grab Bag, 10 Asstd. Types, TR-422 1.19	50	
Calculator IC Chip, Nortec 4202, TR-424 6.00	2.99	
SCR Grab Bag, 25 Asstd. Types, TR-446 . 2.69	.90	
Cadium Photo Cells, Pkg. of 2, TR-512 90	.49	
12 Digit Calculator IC, XM-330 6.00	1.49	
20 Key Calculator Keyboard, XM-339 6.00	1.29	
Send to: Olson Electronics, Dept. IX 260 S. Fo	orge St	
Akron, Ohio 44327. Allow for Postage, C.O.D.	20% De-	
posit. Ohio Residents Add 4% Sales Tax.		

CIRCLE NO. 43 ON FREE INFORMATION CARD

Ask for our Catalog when you Order

GOVERNMENT SURPLUS

MANUALS for Govt Surplus radios, test sets, scopes. List 50 cents (coin). Books, 7218 Roanne Drive, Washington, D.C. 20021

GOVERNMENT SURPLUS. Buy in your Area. How, where. Send \$2.00. Surplus, 30177-PE Headquarters Building. Washington, D.C. 20014.

JEEPS, TRUCKS, Typically from \$52.40... Automobiles, Boats, Motorcycles, Airplanes, Oscilloscopes, Tools, Clothing, Sports, Camping, Photographic, Electronics Equipment ... 200,000 Bid Bargains Nationwide Direct from Government ... Low as 2 cents on Dollar! Surplus Catalog and Sales Directory \$1.00 (refundable). National Surplus Center, 240 Eastcass-PEL, Joliet, Illinois 60432.

MUSICAL INSTRUMENTS

UP TO 60% DISCOUNT, Name brand instruments catalog. Freeport Music, 114 G. Mahan St., W. Babylon, N.Y. 11704.

ì	-	_				
			7400	TTL		
	7425 7427 7428 7430 7432 7437 7438 7440	21 21 21 21 24 45 25 25 25 20 85 43 43 43 150 43 37 40 40 41 41 41 41 41 41 41 41 41 41 41 41 41	7442 7448 7450 7451 7453 7454 7462 7473 7474 7475 7482 7483 7486 7480 7490 7491 7492 7493 7495 7495 7496 7490 7491 7492 7493	1 08 1 15 26 27 27 41 22 39 45 45 85 115 115 120 82 82 91 91 1 25 49	74121 74122 74123 74126 74126 74131 74151 74153 74154 74155 74164 74165 74164 74175 74180 74181 74181 74191 74191 74197	55 60 81 3 00 1 15 1 10 1 25 1 25 1 21 1 30 1 45 1 65 1 70 1 95 1 95 1 100 1 100 1 30
ı						

	7	4L SERI	ES	TTL	٠.
4L00 4L10 4L30 4L42 4L86 4LS00	33 33 33 50 69 39	74LS04 74LS10 74LS20 74LS51 74LS74 74LS112	39 39 39 65	74LS113 74LS138 74LS174 74LS386 74S153 74S387	9 1 8 9 2 5 1 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

	_				
74H00	33	74H11	33	74H53	39
74H01	33	74H20	33	74H55	39
74H04	33	74H21	33	74H73	59
74H05	35	74H30	33	74H74	59
74H10	33	74H40	33	74H76	60

5400 SERIES 5400 1 00 5404 1 25 5410 1 00 5426 1 25

5473 1		LS04 1 0	
	C N	ios	
4001AE	29	4022AE	1 20
4002AE	29	4023AE	29
4007AE	29	4024AE	1 50
4009AE	58	4025AE	35
4010AE	58	4026AE	1 49
4011AE	29	4028AE	1 60
4012AE	29	4029AE	290
4013AE	52	4030AE	65
4015AE	1 25	4037AE	4 50
4016AE	65	4040AE	2 40
4018AE	1 10	4044AE	150
4019AE	65	4047AE	2 75
4020AE	1 75	4049AE	75
4021AF	1.50	4050 A F	75

		MC1741CG	98
MC725P	1 50	MC1804P	98
MC740L	1 55	MC1806P	98
MC790P	1 50	MC1810P	98
MC832P	48	MC2053L	45
MC1004L	1 25	MC3004L	1 32
MC1008L	1 25	MC3006P	1 44
MC1010L	1 25	MC3007P	1 32
MC1011L	1 25	MC3021L	2 15
MC1036L	12 50	MC3021P	2 15
MC1037L	12 50	MC3060L	2 65
MC1352P	1 05	MC3062L	3 00
MC1406CP	3 95	MC4024P	2 20
MC1468L	2 90	MC14501CP	31
MC1469R	2 50	MC14502CP	1 18
MC1510G	8 00	MC14507CP	82
MC1514L	4 50	MC14510CP	2 40
MC1550G	1 50	MC14511CP	2 76
MC1558	4 37	MC14512CP	192
MC1595L	6 25	MC14519CG	94
MC1596G	3 31	MC14519CG	1 74
MC1723CG	1 25	MC4044P	
MC1723CG	1 23	MC4U44P	4 80
		DOG	TIME

MOTOROLA CIRCUITS

		MISC CIRCU	IITS
BC184L CA3001 CA3005 CA3006 CA30018 CA3018A CA3026 CA3028 CA3035 CA3039 CA3058 CK707P CS134J CS134J CS135 CS136 C3(GE) LM301AN	60 75 80 7 10 1 60 2 15 2 45 1 35 1 90 1 15 1 20 1 25 1 50 35	LM309K 1 95 LM351AN 7 40 LM741CP 40 LM1458M 65 MFC99020 1 15 MR995A 1 05 MS09967P1.50 MS558 55 N8598B 5.00 NE555V 45 PA771131 45 PC14370B 35 SC9962P 70 SC9968P 1 25 SN15830N 50	SN15844N 55 SN15946 55 SN158097N 60 SN722560P 4 50 SN7227410N 85 SN7227410 45 SN722748P 49 UA703C 95 UA703C 95 UA703C 95 998079 9 25 998079 9 12 50 998079 9 12 50 998079 1 10 936-5D 1 10 9313DC 1 20 9313DC 2 75

REGULAT	DRS
LM340K-5	1 95
LM340K-6	1 95
LM340K-8	1 95
LM340K-12	1 95
LM340K-15	1 95
LM340K-18	1 95
LM340K-24	1 95
LM340T0-5	1 75
LM340T0-6	1 75
LM340T0-8	1 75
LM340T0-12	1 75
LM340T0-15	1 75
LM340T0-18	175
LM340T0-24	1 75

REGULATORS AVAILABLE

JAPANESE CIRCUITS 4 05 STK056 5 20 STK415 5 20 TA7045M 4 25 TA7054P 4 70 TA7054P 4 70 TA7054P 4 85 TA7061P 4 85 TA7061P 4 85 TA7074P 4 85 TA7075P 3 50 TA7074P 4 85 TA7076P 3 10 TA7102 2 40 TA7102 2 40 TA7120P 2 40 TA7120P 5 40 TA7120P 6 50 TA7146P 6 50 TA7146P 6 50 TA7150P 12 50 TA7150P 12 50 TA7150P 12 50 TA7150P 12 50 TA7150P 11 35 TA7201P 6 40 3.50 TA7203P 7.00 3.50 TA7203P 6 50 3.05 TA7205P 6 50 5.50 TA78005M 2 50 1.85 TA78005P 1.95 2.25 TA78012M 2.50 4.00 TA78012P 1.95 2.25 TA78015M 2 50 4.00 TA78015P 1.95 4.90 TO9100P 12.00 4.55 UPC16C 2.50 2.90 UPC20C 5.00 5.15 UPC41C 3.95 2.20 UPC564C 3.95 2.20 UPC563H2 8.00 2.23 UPC566H2 2.55 3.95 UPC1020H 5.50 6.90 UPC1025 5.50 6.90 UPC1025 5.50 AN136 2 90 AN203 3 75 AN208 4 75 AN210 3.10 AN211 3 30 AN214 4 90 AN217 3 30 AN229 6.35 AN234 5 75 AN239 6.50 AN241 3.20 AN245 6.50 AN245 3.50 AN245 3.50 AN245 4.80 AN246 4.80 AN247 3.50 AN247 3.50 AN247 3.50 AN247 3.50 AN247 3.50 AN248 4.80 AN248 4.80 AN328 4.80 AN328 4.80 AN328 4.80 AN328 5.50 MA1312 HA1329 LA1201 LA1364 LA1366 LA1367 LA3001 LA40301 LA40301 LA4031P LA4051 LD3120 LD3140 M5115 M5115 M5115 SG613 STK015 STK015 STK015 STK015

					HOVE	
BBD BU	JCKET BR	IGADE	DEVICE			•
MM3001	19.50	MN300	2 11.70	MA	A3003 9.45	s
MALL IC	DN834	1.25	DN837			
	DN835	1.35	DN838			
SN76001	1 75		6002			
PLI_02A	MIDLAND				12 00	
					15.00	

MICROPROCESSOR CHIPS					
1404A	3 25	2102	2 50	MM5013	3.25
C1702A	19 95	C2708	95 00	8008	19 95
2101	6 95	C4702A	19 95	8080A	29 95
MK4200	P-11 409	96x1 Bit Dyma	nic Ram		9 95
C5101-3	10	24 Bit (256x4)	Static C-N	los Ram	4 50
MC14514	4.6	Bit Latch 4 to	16 Line De	coder	4.25
(CALL OR	WRITE FOR F	URTHER I	NFORMATION,	
		SPEC'S A	VALLABLE		

ELECTROLYTIC
CAPACITORS

2 2MF50	AXIAL LEADS	15
3 3MF10	AXIAL LEADS	15
3.3MF10	NO POLARITY	.15
10MF25	AXIAL LEADS	.15
10MF50	AXIAL LEADS	15
10MF150	AXIAL LEADS	.20
25MF35	AXIAL LEADS	15
30MF25	AXIAL LEADS	15
47MF25	RADIAL LEADS	15
47MF50	RADIAL LEADS	20
100MF16	RADIAL LEADS	15
100MF25	RADIAL LEADS	20
500MF50	AXIAL LEADS	60
1000MF35	AXIAL LEADS	65

CARBOI	N RES	SIST	rors
Minimum !	5 Pc's	Per	Value
	_		

QUANTIT	Y			
PRICING	5-25	30-95	100-4	95
1 4W5%	06	05	.04	
12W5%	08	07	.06	
STANDAR	RD RES	ISTANC	EVALL	JES
OHMS				
10	270	820	4 7K	27K
22	300	910	5 1K	33K
47	330	1 0K	6 8K	47K
51	470	1 5K	7 5K	100F
100	510	2.2K	8.2K	330k
150	560	2 7K	10K	1 0M
220	680	3.3K	15K	
240	750	3 9K	22K	

STORS	
er Value	

0 8: 0 9: 0 1	10 5	6	rK BK
0 8: 0 9: 0 1	ANCE V 20 4 10 5	7K 27 1K 33	rK BK
0 8: 0 9: 0 1	20 4 10 5	7K 27	rK BK
0 9	10 5	1K 33	3K
0 9	10 5	1K 33	3K
0 1			
	0K 6	8K 47	'K
0 1	5K 7	5K 10	OK
0 2	2K 8.	2K 33	30K
0 2	7K 10	DK 1	0M
0 3.	3K 15	5K	
0 3	9K 22	2K	
	0 3	0 3.3K 1	0 3.3K 15K

HOBBY SPECIALS

	YOU TEST EM SAVE BIG MONEY	
Power Fac	100 Asst (includes Case T03 T066 T0220, T0202)	\$2.99
Transistor/ Diode Pac	100 Asst (includes Case T05, T039, T018, D07, 0041)	\$199
I C Pac Resistor Pac	100 Asst (includes 14 & 16 Pin) 50 Asst (Assorted values)	\$3.50 \$1.50
Mos Fet Pac	10 Asst (many top #'s Case T072)	\$0.99
SCR Pac	100 Asst (similar to C103 Series) Case to 92, VR 10-100V, I 400MA IGT:200MA	\$4.00
-		$\overline{}$

ZENER DIODES
1, & 1 Watt 10% .30 each UP TO 33V.
GREATER THAN 33V CALL FOR PRICING

		-
PACE/PATHCOM	PART	#'S

130079	4.00	IP20-0123	2 75
1300821	.65	IP20-0131	2.50
13-0122	1.75	IP20-0141	3.00
83-0005	2.00	IP20-0142	3.00
83-0007	2.50	IP20-0139	43
83-0008	2 00	IP20-0154	6 00
83-0015	3.00	IP20-0155	2 50
IP20-0005	3.00	IP20-0161	
IP20-0016	.40	IP20-0177	2 75
IP20-0034	.85	IP20-0176	
IP20-0037		IP20-0191	.72
IP20-0045	2.00		
IP20-0073	275		
IP20-0093			

JAPANESE TRANSISTORS + CB, AUDIO, INDUSTRIAL

2SA52	60	200000		000774	. 70	0004470	0.5	20077	
2SA316	75	2SC206	1 00	2SC774	1 75	2SC1173	95	2SD77	1 00
		2SC240	1 10	2SC775	2 75	2SC1175	65	2SD81	3 25
2SA473	75	2SC291	65	2SC776	3 00	2SC1209	55	2SD88	1 50
2SA483	1 95	2SC292	3.00	2SC777	4 00	2SC1213	75	2SD118	3 25
2SA489	80	2SC320	75	2SC778	4 00	2SC1226/		2SD130	1 25
2SA490	70	2SC352	75	2SC781	3 00	2SC1237	4 50	2SD141	2 25
2SA505	.70	2SC353	75	2SC783	1 00	2SC1239	4 00	2SD151	2 25
2SA564	.50	2SC371	.70	2SC784	.70	2SC1243	1 50	2SD170	2 00
2SA628	.65	2SC372	.70	2SC785	1.00	2SC1293	85	2SD180	275
2SA643	85	2SC394	70	2SC789	1.00	2SC1306	4 75	2SD201	1 95
2SA647	2 75	2SC458	.70	2SC793	2 50	2SC1307	5 75	2SD218	4.75
2SA673	85	2SC460	70	2SC796	3 15	2SC1308	4 75	2SD235	1.00
2SA679	3.75	2SC478	.80	2SC797	2 50	2SC1317	60	2SD300	2.50
2SA682	85	2SC481	1.85	2SC798	3 10	2SC1318	70	2SD313	1 10
2SA699	1 30	2SC482	1 75	2SC799	4.25	2SC1325	4.95	2SD315	75
2SA699A	1.45	2SC491	2.50	2SC802	3.75	2SC 1327	70	2SD316	2.50
2SA705	55	2SC495	1 10	2SC803	4 00	2SC1338	1 75	2SD317	1 25
2SA815	.85	2SC497	1 60	2SC815	75	2SC1346	80	2SD318	.95
2SA816	.85	2SC502	1.50	2SC828	75	2SC1347	80	2SD325	1.25
20/10/10	.00	2SC515	.80	2SC829	.75	2SC1364	1 50	2SD341	.95
2SB22	.85	2SC517	4 25	2SC830	1.60	2SC1377	5.50	2SD350	3 25
2SB54	70	2SC535	75	2SC838	70	2SC1383	.75	2SD352	80
2SB56	.70	2SC536	.65	2SC839	.85	2SC 1383	.65	2SD382	5.70
2SB77	70	2SC536							
	2.25		.70	2SC922	.55	2SC1409	1.25	2SD389	.75
		2SC563	2.50	2SC929	.70	2SC1410	1.25	2SD390	.75
	4.50	2SC607	1 25	2SC930	.65	2SC1447	1 25		
2SB173	55	2SC614	3.80	2SC938	.65	2SC1448	1 25	2SF8	3.00
2SB175	.55	2SC615	3 90	2SC943	1.50	2SC1449	1.30	2SCF8	3.50
2SB178	1.00	2SC616	4.15	2SC945	.65	2SC1475	1.50	2SCF6	1.25
2SB186	.60	2SC617	4.25	2SC959	3.15	2SC1507	1.25	HEPS3001	3.25
2SB187	.60	2SC620	.80	2SC960	2.75	2SC 1509	1.25	JSP7001	.75
2SB235	7.00	2SC627	1.75	2SC984	1.50	2SC1569	1.25	MRF8004	3.00
2SB303	.65	2SC642	3.50	2SC996	4.90	2SC1674	1.75	MPS8000	1.25
2SB324	1.00	2SC643	3.75	2SC1010	.80	2SC1875	1.75	MPS8001	1.25
2SB337	2.10	2SC644	70	2SC1012	.80	2SC1678	5.50	MPSU02	.50
2SB367	1.60	2SC681	2.50	2SC1013	1.50	2SC1679	4.75	MPSU31	4.00
2SB370	.65	2SC684	2 10	2SC1014	1.50	2SC1756	1.25	SK3047	3.75
2SB405	.85	2SC687	2.50	2SC1017	1.50	2SC1760	2 15	SK3048	3.25
2SB407	1.65	2SC696	3.00	2SC1018	1.50	2SC1816	4.50	SK3049	4.75
2SB415	.85	2SC699	4.75	2SC1030	4.75	2SC1908	.70	SK3054	1.25
258461	1.25	2SC710	.70	2SC1051	2.50	2SC1909	4.75	2SK19	1 75
2S8463	1.65	2SC711	.70	2SC 1060	.75	2SC1957	1.50	2SK30	1.00
2SB471	1.75	2SC712	.70	2SC1061	1.65	2SC1973	1.50	2SK33	1.20
258474	1.50	2SC713	.70	2SC1069	3.50	2SC1974	4.90	2SK41	1.75
	1.25	2SC731	3.00	2SC1079	3.75	2SC1975	4.90	3SK22Y	2.75
	2.10	2SC732	.70	2SC1080	3.75	2SC2028	1.10	3SK40	2.75
2SB492	1.25	2SC733	.70	2SC1096	1.20	2SC2029	4.75	3SK45	2.75
2SB495	.95	2SC735	.70	2SC1098	1.15	2SC2074	3.00	3SK49	2.75
2SB507	.90	2SC739	.70	2SC1115	2.75			4004	3.00
2SB511	.70	2SC715	.70	2SC1166	.70	2SD45	2.00	4005	3.00
	3.00	2SC756	3.00	2SC1167	4.25	2SD65	.75	40080	1.25
	3.50	2SC762	1.90	2SC1170	4.00	2SD68	.90	40081	1.50
2SB135	.95	2SC773	.85	2SC1172B	4.25	2SD72	1.00	40082	3.00

2N2160 .85 MU4892 2N2646 .45 MU4893 2N2647 .55 MU4894 2N4851 .75 2N6027 2N4852 .75 2N6028 2N4870 .50 D5E37 2N4871 .50 MU10 MU4891 .50 MU20 .50 .50 .55 .70 .35 .35 .40

POPULAR JEDEC SEMICONDUCTORS

1N34	25	2N918	60	2N2218	25	2N2908A		2N3646	14	2N4220A	45
1N60	25	2N930	25	2N2218A		2N2907	25	2N3730	2.50	2N4234	95
1N270	40	2N956	.30	2N2219	.25	2N2907A	30	2N3731	3.75	2N4400	.16
1N914	10	2N960	90	2N2219A		2N2913	.75	2N3740	1.00	2N4401	.16
		2N962	95	2N2221	.25	2N2914	1.20	2N3771	1.75	2N4402	.16
2N173	1 75	2N967	.95	2N2221A		2N2916A		2N3772	1.90	2N4403	.20
2N174	3.50	2N1136	1 75	2N2222	.25	2N3019	.50	2N3773	3.00	2N4409	.16
2N17B	90	2N1142	2.25	2N2222A		2N3053	.30	2N3819	40	2N4410	16
2N327A	1.15	2N1300	1.00	2N2223	1.00	2N3054	70	2N3823	.70	2N4416	.75
2N334	1 20	2N1301	1.10	2N2270	.40	2N3055	.75	2N3858	.20	2N5061	.30
2N336	.90	2N1302	1.25	2N2323	1.00	2N3227	1.00	2N3886	.85	2N5064	.50
2N338A	1 05	2N1303	.70	2N2324	1.35	2N3247	3.40	2N3903	.16	2N5130	.20
2N398B	1 50	2N1304	1.25	2N2325	2.00	2N3250	.50	2N3904	.18	2N5133	.15
2N404	75	2N1305	.75	2N2326	2.85	2N3375	8.50	2N3905	.16	2N5138	.15
2N443	2.50	2N1306	1.35	2N2327	3.80	2N3393	.20	2N3908	.16	2N5198	3.75
2N456	1.30	2N1307	.75	2N2328	4.25	2N3394	.17	2N3925	3.75	2N5294	.50
2N501A	3.00	2N1308	1.50	2N2329	4.75	2N3414	.17	2N3954	3.50	2N5296	.50
2N508A	.45	2N1309	.90	2N2368	.25	2N3415	.18	2N3954A	3.75	2N5306	.20
2N555	75	2N1552	3.25	2N2369	.25	2N3416	.19	2N3955	2.45	2N5354	.20
2N652A	1.25	2N1554	1.25	2N2484	.32	2N3417	.20	2N3957	1.25	2N5369	.20
2N677	8.00	2N1557	1.15	2N2712	.18	2N3442	1.85	2N4036	.75	2N5400	.40
2N706	.25	2N1560	2.80	2N2894	.40	2N3553	1.50	2N4037	.60	2N5401	.50
2N706B	.75	2N1605	.35	2N2903	3.30	2N3583	.20	2N4093	.85	2N5457	.35
2N711	.90	2N1613	.30	2N2904	.25	2N3585	.20	2N4124	.16	2N5458	.30
2N711B	1.10	2N1711	.30	2N2904A	.30	2N3638	.20	2N4126	.18	CIO3Y	.25
2N718	.25	2N1907	4.10	2N2905	.25	2N3642	.20	2N4141	.20	C106B1	.50
2N718A	.30	2N2060	1.85	2N2905A		2N3643	.20	2N4142	.20		
2N720A	50	2N2102	.40	2N2906	.25	2N3645	.20	2N4143	.20		

HARDWARE + IC SOCKETS

lyton Screws, Nuts & Rivets (Complete Kit, 50 pc's) rans H/W Mica, Bushings & Screws	1.99	10 For	100 For
Case T03, T066 & T0220 (Specify Type, 10 Sets)	1.00 IN4001	.60	5.00
	7.99 IN4002	.70	6.00
	7.99 IN4003	.80	7.00
	0es. IN4004	.90	8.00
	288. IN4005	1.00	9.00
	5ea. IN4006	1.10	10.00
	7es. IN4007	1.20	11.00

NEW-TONE ELECTRONICS PO BOX 1738A **BLOOMFIELD, N.J. 07003** PHONE: (201) 748-6171, 6172, 6173

Thank you, for your interest and response to New-Tonel

N.J. residents add 5% sales tax, minimum order \$5.00. Phone Orders Welcome
All orders add \$1.00 Postage \$1.50 Canada Dealers Write or Phone for Discount Prices

PARTIAL LISTING - WRITE FOR FREE CATALOG

RECTIFIERS



036 CIRCLE NO. 26 ON FREE INFORMATION CARD

For faster service

BULLET ELECTRONICS

HITRASONIC SENDER-BECEIVER KI

A special buy on a nigh quality ultrasonic transducer allows us to offer this kit at a super price — but hurry, quantities are limited You can build intrusion alarms, motion detectors, remote controls, echo ranging or liquid level measurement equipment. We supply the basic transmitter or liquid level measurement equipment. We supply the basic transmitter and receiver electronics including a drilled and plated PC board. The units work at 23KHZ with a range of 20 ft, and can be positioned opposite each other or side-by-side and bounced off a solid surface. The output will sink up to 300ms to drive a relay, alarm circuit, etc.

ORDER US—01 **

\$19.95

AUTOMATIC TIME-OUT CIRCUIT for ultra-

sonic or mechanical switch alarms. Provides a five second entry delay. Sounds alarm for one minute, then re-arms itself. Requires 6-15VDC. \$3.95

MK-03 AIRCRAFT CLOCK/TIMER KIT

24 hour real time and up to 24 hrs. elapsed time are available independently on the same set of 6.4" LED readouts. Clock has presettable alarm. Timer has reset, hold and count functions. Size 44" IX 24" IX 1 3/6" Allows mounting in standard instrument case. Because of the many options and mounting variations the kit is sold less case & switches. The unit has noise and over voltage protection. For 9 to 14TOC.

QUALITY PC BOARD & COMPONENTS.

MINI GRANDFATHER CLOCK KIT

Would you give over one hundred dollars for a completely ELECTRONIC GRANDFATHER CLOCK KIT?? completely ELECTRONIC GRANDFATHER CLOCK KIT??
Well, what if it had large ½" LED readouts...
and LED SWINGING PENDULUM a TICK-TOCK SOUND &
a super SWITHESIZED OSCILLATOR with frequency
volume and sustain adjust and it CHIMED THE
HOURS (like 3 times for 3 o'clock)? What if
we gave you all the components, xfmr, spkr, a
set of quality plated boards; and told you
it was 6.5" X 4.5"? Still not good enough???
Then how about for \$39.95? Now that's a DEAL.

BUILD A COMPLETE CDI IGNITION KIT AT A FRACTION OF THE COST OF OTHER UNITS. A special buy allows us to sell the complete kit at this low price! Up to 40,000 volts from your present ignition without changing the coil. Simple INCLUDES:

Special toroid transformer Drilled and Plated board Complete instructions All resistors and caps

All semiconductors (Does not include heatsink or case.) For 12V negative ground

TERMS: NO COD's * Send check or M.O. * Add 5% postage Tx. res. add 5% tax * Foreign add 10% (20% airmail) * Orders under \$10. add 60¢ handling * Repair service a-vailable * Accepting phone orders on Master Chg & BAC.



everything else you want to know in the . . . 1977 COMMUNICATIONS **HANDBOOK**

Here's everything you want to know—need to know
—about Citizens Band Radio, Amateur Radio, Shortwave Listening, Police-Fire Monitoring, Marine Radio.
Features, specifications, latest prices and photos of
equipment on the market are at your fingertips in the
Handbook's directory buying sections. CITIZENS BAND
—The new modified FCC rules, how to get started (no
test, no fee), how it's used, buying tips, the 40channel transceivers . PUBLIC SERVICE BAND
Monitor radios for listening in on police, fire, mobile
telephone, airline conversations and weather reports
. AMATEUR RADIO—How to get started, license telephone, airline conversations and weather reports. . AMATEUR RADIO—How to get started, license privileges and study tips, slow-scan TV, satellite communications, new Novice rules . . . MARINE RADIOTELEPHONE—Rules and regulations for pleasurecraft, two-way radio equipment types . . SHORT-WAVE 1977—Latest happenings in the SW field, international stations to listen to, SW clubs, utility broadcast listening without knowing Morse Code, IN ALL, A ONE-STOP BUYING GUIDE FOR ALL CONSUMER COMMUNICATION RADIOS AND TRANSCEIVERS! Only \$1.95!

PE-577

COMMUNICATIONS HANDBOOK, Consumer Service Division, 595 Broadway, New York, N.Y. 10012.

Please send the 1977 Communications Handbook. I'm enclosing \$2.50 (\$1.95 plus 55c for postage and handling). Outside U.S.A. \$3.00, postpaid.

Residents of CA, CO, FL, IL, MI, MO, NY STATE, DC and TX add applicable sales tax. Postage and handling charges non-taxable.

Print name... Address.

City Zip PLANS AND KITS

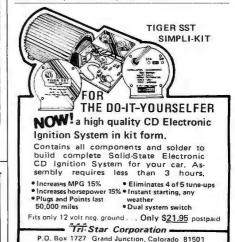
AMAZING ELECTRONIC PRODUCTS A

LASERS SUPER POWERED. RIFLE, PISTOL, POCKET. SEE IN DARK PYRO-TECHNICAL DE BUGGING UNCRAMBLERS, GIANT LESLA STUNWAMD. PO DISRUPTER - FURREY PRODUCING, SCIENTIFIC DETECTION, ELECTRIPPING, CHEMICAL ULTRASONIC, CB AERO, AUTO AND MECH DEVICES, HUNDREDS MORE ALL HEW PLUS INFO UNITLD PARTS STRUCE

CATALOG \$1

INFORMATION unlimited

FREE KIT Catalog contains Test and Experimenter's Equipment. Dage Scientific Instruments, Box 1054P, Livermore, CA 94550.



MORSE-A-LETTER KIT - Decodes/displays Morse code See January "Popular Electronics". Complete parts kit except chassis/capine: \$109.95 Eiched, drilled PC board \$17.95. SELECT CIRCUITS, 1411 Lonsdale Road, Columbus, Ohio 43227

TAPE-SLIDE synchronizer, lap-dissolve, multiprojector programmer plans, \$5.50 Free catalog, Millers, 1896 Maywood, S. Euclid, OH 44121.

DIGITAL Circuits Timers, Clocks, combination lock, meters, testers. New and advanced. Stamp for catalog GeeBee, Box 1661, Downey, Calif. 90240.



POCKET COLOR/BAR GENERATOR kit. 16 patterns. \$49.95. Plans. \$4.95. Workshop. Box 393PA. Bethpage. New York 11714.

FIVE OCTAVE Touch Sensitive Electronic PIANO Kit. Components \$245 airmail U.S.A., Canada, Clef Products, 31 Mountfield Road, Bramhall, Cheshire, England.

THE "KING OF KITS", Artisan Organ Kits feature all new modular construction, with logic-controlled stops and RAM Preset Memory System, Write for brochure to: A O K Manufacturing, Inc., P.O. Box 445, Kenmore, WA 98028. AMPLIFIER KITS: 35 watts output 0.5% THD, \$15 to Benchmark, 2149 Stuart St. Berkeley, CA 94705.

TESLA COIL-40" SPARKS! Plans \$7.50. Information 75 cents. Huntington Electronics. Box 2009-P. Huntington. Conn 06484.

250MHZ PRESCALER for 25 Mhz counters. Protected 50 ohm input, \$19.95. Free literature, MLG Enterprises, P.O. Box 788, Laconia, N.H. 03246.

CATALOGS

FREE! Consumer Service Division Catalog. Includes a wide variety of products associated with the special interests of readers of Ziff-Davis magazines — PSYCHOLOGY TODAY, POPULAR PHOTOGRAPHY, STEREO REVIEW, POPULAR ELECTRONICS, BOATING, FLYING, CAR & DRIVER, CYCLE, SKIING. Send for YOUR free catalog today. Consumer Service Div.: 595 Broadway, Dept. CL., N.Y., NY 10012

Radio Hut

Money back guarantee. NO COD'S. residents add 5% sales tax. Add 5% of order for postage and handling. Orders under \$15.00 add 75 cents. Foreign orders add 10% for postage.

For your convenience, call your BankAmericard or Master Charge orders in on our Toll Free Watts Line: 1-800-527-2304. Texas residents call collect: 1-214-271-8423.



P. O. Box 64783P Dallas, Texas 75206



1 Amp

6 Amp

10 Amp

25 Amp

INAMOISTO	119 - 011	
*MJE1103	3/1.00	
MJ3001	1.30	
2 N2 2 2 2	6/1.00	
2 N2 3 6 9	6/1.00	
2 N2 9 0 5	4/1.00	
*2 N2907	15/1.00	
2 N3 9 0 6	6/1.00	
2 N4 4 0 0	6/1.00	
2 N4 4 4 3 SCR	3 /1 .00	
RCA 200 V 115 W		
1 N4 0 0 4	15/1.00	
1 N4 0 0 7	10/1.00	
1N4148 (1N914)		
3 N201 VHF Pre a		
D40 C1 Power Dar		5 /1 .

*House numbered and P.C. Lead

PLASMA DISPLAY KIT

Kit Includes: 12 digit display .4" Character Power supply for display above Complete specs for

hookup.

Line cord Not Included.

ONLY \$3.95

9.0.2. 1.5.5.3.7.9.

UNSCRAMBLER KIT

for all Scanners

- Tunes easily
- Full instructions included
- · Easy to install
- 3½" x 3½" x 1½"

ONLY \$14.95

CLOCK KIT

Kit includes • LT701 clock module

- Power Supply
- Punched case
- 12 or 24 hour operation

Complete except for line cord

LT701E 12 hour clock LT701G 24 hour clock

ONLY \$14.95

	CMOS	SALE	
CD4000	.16	CD4040	1.00
CD4001	.16	CD4041	.69
CD4002	.16	CD4042	.59
CD4007	.16	CD4043	.60
CD4009	.45	CD4044	.59
CD4010	.45	CD4047	.59
CD4011	.16	CD4049	.35
CD4012	.16	CD4050	.35
CD4013	.29	CD4051	.90
CD4014	.75	CD4053	.90
CD4015	.75	CD4056	1.00
CD4016	.29	CD4058	.90
CD4017	.80	CD4060	1.00
CD4018	.80	CD4066	.69
CD4019	.39	CD4069	.30
CD4021	.90	CD4071	.16
CD4022	.90	CD4076	.99
CD4024	.70	CD4077	.39
CD4025	.19	CD4102	.68
CD4027	.39	CD4116	.39
CD4028	.75	CD4507	.40
CD4029	.99	CD4512	.50
CD4030	.16	CD4516	.85
CD4034	2.30	CD4518	.85
CD4035	.99	CD4520	.85

TRANSISTORS - DIODES

Memorex computer boards with IC's, diodes, transistor, etc.

5 Boards containing

100 - 200 IC's **ONLY \$4.25**

BRIDGE RECTIFIERS

50V

50V

50V

50V

85

1 10

1.25

1 39

110101010	110 - 011	
*MJE1103	3 /1 .00	
MJ3001	1.30	
2 N2 2 2 2	6/1.00	
2 N2 3 6 9	6/1.00	
2 N2 9 0 5	4/1.00	
*2 N2907	15/1.00	
2 N3 9 0 6	6/1.00	
2 N4 4 0 0	6/1.00	
2 N4 4 4 3 SCR	3 /1 .00	
RCA 200 V 115 W	NPN .95	
1 N4 0 0 4	15/1.00	
1 N4 0 0 7	10/1.00	
1N4148 (1N914)		
3 N201 VHF Pre a	mp .80	
D40 C1 Power Dar		5/1.

WATERGATE SPECIAL

Telephone Relay automatically starts and stops tape recorder. No batteries required. Kit complete with drilled P.C. Board.

Parts and Case **ONLY \$9.95**

TI CALCULATOR CHIPS

TMS103 w/specs. TMS107 w/specs.

HARDWARE

New, includes 2-56, 4-40, 6-32 and 8-32 screws and nuts. A very usable selection. ½ pound \$1.50

1 pound \$2.60

PROJECT CASES

SMALL \$1.50	MEDIUM \$2.00	LARGE \$2.75
D - 2-1/2"	D - 2"	D - 2-1/2"
W - 4-3/4"	W - 4-7/8"	W - 7"
H - 1-7/8"	H - 3-1/2"	H - 4"
All cases have	ve a sloped from	nt. white with

black wrinkle finish.

LOW POWER SHOTTY

74LS00	.25	74LS74	.49	
74LS02	.25	74LS90	.85	
74LS04	.30	74LS132	.90	
74LS08	.25	74LS138	.89	
74LS10	.25	74LS139	.89	
74LS11	.32	74LS155	.90	
74LS20	.31	74LS157	1.00	
74LS21	.33	74LS162	1.39	
74LS22	.33	74LS163	1.39	
74LS27	.30	74LS175	1.09	
74LS30	.31	74LS193	1.09	
74LS32	.33	74LS258	1.09	
74LS37	.40	74LS367	.70	
74LS38	.35	74LS368	.70	

ORDER BY PHONE. Charge your order to BankAmericard or Master Charge. Use our Toll Free Watts

1-800-527-2304

READOUTS

FND70	.4" C.C.	.59	
FND800	.8" C.C.	1.69	
TI 6 digit	array C.C.	3/1.00	
8 NAM	.3" CA Yellow	.89	
LT767	.7" C.C. 4 digit stick	3.25	

POSITIVE VOLTAGE REGULATORS

LM340-5	LM340-15
LM340-6	LM340-18
LM340-8	LM340-24
LM340-12	

To-220 case. Your Choice .75 Each

NEGATIVE REGULATORS

7905 7912

To-220 case. Your Choice .75 Each

FINNED HEATSINK for above regulators

2-3/4" High 2-1/2" Wide 1" Depth ONLY 39 Each

HEATSINK with pass transistor to increase regulator to 5 amps.

ONLY .99 Each

BATTERY CLIPS

Standard 9V battery clip with 41/2" tinned leads. 25/\$1.00

LINEARS

LM309 K	.95
LM380 (8 Pin)	.75
LM380 (14 Pin)	1.00
LM3900	.30
LM710	25
LM711	25
LM723	.40
LM748	.25
NE555	.35
NE556	.95
NE565	.95
NE566	.95
NE567	1.10
1458	.49
RCA 3043	.75
75491	.75
75492	25

60Hz Crystal Time Base Kit - Kit enables a MOS clock circuit to operate from a DC power source, Ideal for car, camper, van, boat, etc.

60Hz output with an accuracy of .005% (typ.) Low power consumption 2.5 ma (typ.). Small size will fit most any enclosure. Single MOS IC oscillator/divider chip 5-15 volts DC operation.

ONLY \$4.95 2 for \$9.00

RESISTORS

Over 50,000,000 in stock ohm 1/8W 330 20K ohm 1/4W 470 ohm 1/4W 22K ohm 1/4W ohm 1/4W 680 ohm 1/2W 27K 1/4W 1K ohm 1/4W 33K ohm 1.2K ohm 1/4W 39K 1/4W ohm 2.2K ohm 1/4W 43K ohm 1/4W 3.3K ohm 1/4W 47K 1/4W ohm 4.7K ohm 1/4W 82K ohm 1/4W 6.8K ohm 1/4W 100K 1/4W ohm 10K ohm 1/4W 150K ohm 1/4W 220K ohm 1/4W

All resistors are PC lead, but are not pull offs. 100 min. order for each value. No Mix. 100/.99 Cents

RADIO HUT GUARANTEE

If you are not satisfied with any of our products NO MATTER WHAT THE REASON we offer you a full money back guarantee if the product or products are returned within 14 days after you receive them.

World's Lowest IC Prices

* SPECIAL PRICES *

MEMORIE	6 1	74152	.90	HIGH SPEE	0 1	4007	.16	
	.	74155	.60	74H00	.20	4008	.70	
Rams		74157	.60	74H01	.20	4011	.16 *	
2102 2102-1	1.50*	74160	.75	74HD4	.20	4012	.16*	
Proms	1.70	74161	.75 *	74H10	.20	4013	.30*	
82S23/S1	23 1.95*			74111	.20	4015	.80	
	23 1.35 -	74163	.75*	74H40	.20	4016	.35*	
TTL		74165	.80	74H51	.20	4019	.70	
7400	.12*	74173	1.25	74H52	.20	4020	90	
7402	.14	74174	.75	74H74	40	4021	.95	
7403	.14*	74175	.75*	74H103	.50	4023	.16*	
7404	.16*	74177	.70	74H106	.50			
7407	.20	74180	.80			4025	.20 *	
7410	.12*	74181	1.50	LOW POW	ER]	4027	.40	
7420	.12*	, , , , ,		SCHOTTKY	1	4028	.60	
7427	.25	74191	.85	74LS00	.29	4030	.35	
		74192	.70*	74LS02	.29	4040	.95	
	1	74193	.70*	74LS08	.29	4042	.60	
7438	.20*	74194	85	74LS10	.29	4043	.75	
7440	.12*	74198	1.25	74LS27	.30	4044	.70	
7441	.65*	9602	.50*	74LS73	.45	4049	.35*	
		9300	.75	74LS75	.65	4050	.35 *	
7445	.60	9312	70	74LS151	1.10	4066	.65	
7447	.75	55.0		74LS153	1.10	4068	.35	
7450	.14	SCHOTTK	v	74LS157	1.10			
7451	.14 at	74501	25	74LS161	1.50*	4071	.16	
7473	.28	74501	.25	74LS163	1.50	4073	.16	
7474	.28			74LS164	1.50	4075	.16	
7475	.40	74\$37	.40	74LS174	1.10*	4516	.85	
7480	.40 *	74538	60	74LS175	1.50	4528	.75	
	1	74585	2.00	74LS193	1.50			
7493	.50	745113	.80	74LS221	1.50 *	LINEARS		
7495	.49	745139	1.50	74LS251	1.50			
74107	.29	745140	.50	74L S253	1.50	NE536T	2.75	
74109	.30	74\$153	2.50	74LS257	1.50	NE555V	.43	
74116	1.50	745172	4 50	74LS258	1.50	NESS6A	.90	
74123	.45*	745174	2 05		1.30	1456V	.75	
74141	.80 *	745175	2.05*	CMOS		1458V	.52	
74145	.75	745181	4.50	4001	.16 *	566V	1.25	
74150	.60 *	745197	2.20	4002	.16	567V	1.35	
74151	60	745257	1.50	4006	.90	540L	2.00	

Order Minimum \$10.00. Add \$1.00 shipping and handling charge per order. California residents add 6° sales tax. All orders shipped First Class within 24 hours.

C.O.D. Orders Phone (day or night) 408/354-1448

PO BOX 2542 -A Sunnyvale, CA 94087

CIRCLE NO. 23 ON FREE INFORMATION CARO

For faster service

CODE

mai

22UF 35V 5/\$1.00 47UF 35V 5/\$1.00 68UF 35V 5/\$1.00

on

BURGLAR ALARMS

DIALING UNIT automatically calls police. \$29.95. Free security equipment catalog. S&S Systems, 5619-C St. John, Kansas City, MO 64123. (816) 483-4612

Burglar . Smoke Fire Alarm Catalog

· Billions of dollars lost annually due to lack of protective warning alarms.

FREE CATALOG Shows you how to



protect your home, business and person. Wholesale prices. Do-it-yourself. Free engineering service.

Burdex Security Co.

Box 82209 Dept. PE Lincoln, Ne. 68501

HOME ENTERTAINMENT FILMS

HOW ARE YOU FIXED FOR 16MM SOUND FILMS? Special Event! Operation Tall Ships, 16mm color sound, special, \$57.95 (you save \$2. + shipping), limited offer. Byron Nelson Golf, 1/4 hr 16mm B&W snd film, \$25. ea! While they last (+ \$2. ea shipping). W.C. Fields, If I Had A Million: Abbott & Costello, Midget Car Maniacs, \$37.95 ea Million; Abbott & Costello, Mildgel Car Maniacs, \$37.95 ea (+ \$1, shipping — you save about \$2.). Home Movie Collectors — Stock Car 500, 200' Stand. 8 color, \$14.95 ea ppd; Foreman/Frazier — Murder In Venezuela, \$15.95 ea ppd, 200' Stand. 8 color, NFL Football Follies or the Moore/Maxim fight, St. 8 B&W, \$7.95 ea (+ \$0.75 shipping). Get started collecting now, or select from new 54-pg Columbia catalog, \$1.00 refundable with order; Castle catalog \$0.50 incl order form; Sportlite forms \$0.35 (coins, stamps, pls). SPORTLITE, Elect-5, 20 N. Wacker, Chicago, 11 60606

Full Wave Bridges

SANKEN AUDIO POWER AMPS

CCD 110 LINEAR 256 XI BIT SELF SCANNING CHARGED COUPLED

2708-BK EPROM \$45 00 2522 STATIC SHIFT RE6 \$ 1.95 2513 CHARACTER GEN \$ 9.95 2518-HEX 32 BIT SR \$ 3.50 2102-1 1024 BT RAM \$ 1.49 5280 4K DYNAMIC RAM \$ 6.95 5202A UV PROM \$ 6.95 MM5203 UV PROM \$ 6.95 1702A UV PROM \$ 6.95 1702A UV PROM \$ 6.95 1702A UV PROM \$ 1.09 1702A UV PROM \$ 1.00 2N3585 NPN Si TO-66 \$.95 2N3772 NPN Si TO-3 . . . \$ 1.60 2N456A PNP GE \$.75 2N3772 NPN Si TO-3 \$1.60 2N456A PNP GE \$7.75 2N4908 PNP Si TO-3 0arlington \$1.70 2N5085 PNP Si TO-3 0arlington \$1.70 2N5085 PNP Si TO-92 4/5 1.00 2N4898 PNP TO-66 \$5.60 2N404 PNP GE TO-5 5/5 1.00 2N3919 NPN Si TO-3 RF \$1.50 MPSA 13 NPN Si TO-92 3/5 1.00 2N3919 NPN Si TO-66 \$5.60 2N3055 NPN Si TO-66 \$5.60 2N3055 NPN Si TO-65 \$5.70 2N2222 NPN Si TO-18 \$5/5 1.00 2N3055 NPN Si TO-69 \$5/5 1.00 2N3056 NPN Si TO-92 \$5/5 1.00 2N3056 NPN Si TO-92 \$5/5 1.00 2N3269 NPN Si TO-92 \$5/5 1.00 2N5269 NPN Si TO-92 \$5/5 1.00 C/MOS (DIODE CLAMPED) (DIODE CL 4015-- .95 4016- .40 4017-1.05 4018-1.00 4019- .25 4020- 1.05 4022- .95 4023- .22 4024- .75 4025- .22 4026-1.25 4027- .40 4028- .88 C/MOS 74C02- 22 74C10- .22 74C193-1.50 4001- .22 4002- .22 4006- 1.20 4007- .22 4009- .42 4010- .42 4011- .22 4012- .22 4035-1.10 4042-.78 4047-2.00 4049-.40 4050-.40 4055-1.50 4066- 80 4071- 22 4076-1.05 MCA-81 OPTICAL LIMIT SWITCH, \$1.50 **LED READOUTS** FND 500-.5" C.C. HP 7740-.3" C.C. MAN-7-.3" C.A. NS 33-3 dig. array DL 747

PRINTED CIRCUIT BOARD 4-1/2" x6 1/2" SINGLE SIDED EPOXY BOARD 1/16" thick, unetched 7 WATTLD-65 LASER DIODE IR \$8.95 2N 3820 P FET . . 2N 5457 N FET . . . TIS 43 UJT TIS 43 UJT ER 900 TRIGGER DIODES 2N 6028 PROG. UJT 8 PIN DIP SOCKETS 14 PIN DIP SOCKETS 16 PIN DIP SOCKETS 18 PIN DIP SOCKETS 24 P™ DIP SOCKETS 24 PIN DIP SUCKETS 40 PIN DIP SOCKETS VERIPAX PC BOARD 116" sided px This board is a 1/16" single sided paper epoxy board, 4½" 16% "DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16, or LSI DIP IC's with busses for RED, YELLOW, GREEN OH AMBER LARGE LED's ...eo. \$.20 MOLEX PINS 100/\$1.00 1000/\$7.50 10 WATT ZENERS 3.9, 4.7, 5.6, 8.2, 10, 12, 15, 18, 22, 100, 150 or 200V ea. \$.60 1 WATT ZENERS 4.7, 5.6. 18 OR 22V ea. \$.25 MC6860 MODEM CHIP \$9.95 Silicon Power Rectifiers .30 .80 .35 1.15 .35 1.15 .50 1.40 .70 1.80 .90 2.30 1.10 2.75 .09 SILICON SOLAR CELLS .4V at 500 ma. \$4.00 / .2V at 200 mils \$2.00 REGULATED MODULAR POWER SUPPLIES

1UF 35V 5 2.20UF 20V5 3.3UF 35V 4	\$1.00 47	UF 35V UF 20V UF 35V	\$ 40 5/\$1.00 \$.35
4 7UF 35V 4	\$1.00 150	UF 15V	\$ 50
NATIONAL			. \$5.75 724; EIGH
MM1402 1.75 MM1403 1.75	MM505	7- 2.25 8- 2.75	SPECTRA FLAT CABL
MM1404- 1.75 MM5013- 2.50	MM506	0-2.75 1-2.50	10'/\$1.50 100'/\$13.5
MM5016 - 2.50 MM5017 - 2.70		5 - 4.75	#30 WIRE WRAP, WIR
MM5055- 2.25 MM5056- 2.25	MM521		SINGLE STRAND 100'/\$1.40
	TTL IC SE		
740015	74457	0 74	15170
740115	74467	0 741	53 .65
740215	7447— .7 7448— .7		54- 1.10 55 .70
740315 740420	7448~ .7 7450~ .2		5770
740420	74723		6185
740625	74733	5 741	63 .80
740725	74743		6495
740825			65-1.05
740921	74763	5 741	73-1.40
741015	74803	5 741	74~ .95
741120	74837	0 741	7592
741220	74858		7675
741345	74863		7779
741470	7489 - 1.8		180 .70
741625	74904	5 741	81-2.10
741725	74917		90-1.20
7420~ .20 7425~ .28	74925 74934		91-1.20 19285
742528 742625	74947		9285 9385
742730	74957		9485
743020	74967	0 741	9575
743225	741073	2 741	9688
743725	741213	8 742	257 - 1,25
743825	741236	5 742	27990
744016	741254	- / -	324- 1.75
744185	741264 741328		9165
744252	TURE DIP S	7.5	9265
CTS-206-4 F	our SPST sw inidip package	ritches	\$1.75
	ight SPST sv		
pin DIP p	oackage	ALCHES II	\$1.95
5-BV SPST Mir	inture cond :	otau ==	smally.
open, 330 Ohn			
ALCO MINIAT MTA 106 SI	URE TOGGL		
MTA 200 D	DOT		C+ 70

TANTULUM CAPACITORS

6.8UF 35V 3/\$1.00 22UF 35V \$.40 30UF 6V \$.40

		TTL IC SERI	EC	301/748-Hi Per. O
	4.5			320T 5,12,15, or 3
	.15		7415170	709C - Op, Amp.
-		744670		78MGS-Pos 5 to 3
	.15		74154- 1.10	79MGS-Neg 5 to 3
	.15		74155 .70	CA 3047 Hi Pef. C
	.20	745020	7415770	340T 5, 6, 8, 12,
	.20	747233	7416185	REG. TO-220
	.25	747335	74163 .80	741A or 741C OP
	.25	747435	7416495	
	.25	747549	74165-1.05	LM 308 Oper. Am
-	.21	747635	74173 1.40	747 - DUAL 741
)—	.15	748035	74174~ .95	556 - DUAL TIM
-	.20	748370	7417592	1456 - Oper. Am
	.20	748588	7417675	LM 3900 - QUAL
-	.45	748630	7417779	LM 324 OUAD
-	.70	7489 - 1.85	74180 .70	560 PHASE LO
i	.25	749045	74181 - 2.10	561 - PHASE LO
_	.25	749170		565 PHASE LO
	.20	749250	74191-1.20	566 FUNCTION O
	.28	749345	7419285	567 - TONE DEC
5-	.25	749470	7419385	LM 1310N FM ST
_	.30	749570	7419485	8038 IC VOLTAC
	.20	749670	7419575	LM 370 - AGC S
_	.25	7410732	7419688	555 — 2µs → 2 HF
_	.25	7412138	74257 - 1.25	553 QUAD TIME
	.25	7412365	7427990	IL5 (MCT-2) OPT
	.16	7412540	75324- 1.75	1458 DUAL OP A
	.85	7412640	7549165	LM 380 - 2W AU
	.52	7413282	7549265	LM 377 - 2W Ste
_				LM 381 - STERE
	MINE	ATURE DIP SWIT	TCHES	LM 382 - DUAL
		Four SPST switch	168	LM 311 - HI PER
10.1	D00 -	ninidia anakasa	04.75	B

DEVICE	\$65.00
CCD 201 - 100 x 100 CHARGE	
COUPLED DEVICE	\$99.00
LINEAR CIRCUITS	
LM307 -Op. Amp	\$.30
LM 309K 5V 1A REGULATOR	\$.95
723 - 40 + 40VV REGULATOR .	
301/748-Hi Per. Op. Amp	
320T 5,12,15, or 24V NEG REG .	S1.25
709C - Op. Amp. , ,	3 71
78MGS-Pos 5 to 30V, 500 ma reg.	\$1.35
79MGS-Neg 5 to 30V, 500 me reg.	\$1.35
CA 3047 Hi Pef, Op. Amp.	. \$ 95
340T 5, 6, 8, 12, 15, 18, 24V POS	
REG. TO-220	. S1.10
741A or 741C OP AMP	. \$.31
LM 308 Oper. Amp., Low Power .	
747 - DUAL 741	. \$.65
556 - DUAL TIMER	. \$1.00
1456 - Oper, Amp	. \$.95
LM 3900 - QUAD OP. AMP	S 49
LM 324 - OUAD 741	S1.50
560 - PHASE LOCK LOOP	- \$2.00
560 – PHASE LOCK LOOP 561 – PHASE LOCK LOOP 565 – PHASE LOCK LOOP	\$2.00
566 FUNCTION GEN	\$1.25
567 - TONE DECODER	- 31.00
567 - TONE DECODER LM 1310N FM STEREO DEMOD.	\$2.75
8038 IC VOLTAGE CONT. OSC.	. \$3.90
LM 370 - AGC SQUELCH AMP.	S1 15
555 - 2µs - 2 HR. TIMER , ,	. S 45
553 QUAD TIMER	S .45
IL5 (MCT-2) OPTO-ISOLATOR .	
1458 DUAL OP AMP	· S .60
LM 380 - 2W AUDIO AMP	- 5 .95
LM 377 - 2W Stereo Audio Amp. LM 381 - STEREO PREAMP	. \$2.50 . \$1.50
LM 382 - DUAL AUDIO PREAMP	\$1.50
LM 311 - HI PER, COMPARATOR	31.50
LM 319 - Dual Hi Speed Comp	\$1.25
LM 339 - OUAD COMPARATOR	\$1.50
TRIACS SCR'S	
IDIACO SCHS	

10A 25A | 1.5A

1.30 .40 .50

1.00

\$1.25 \$.95 \$.95 \$.75 \$1.60



OF OUR ORDERS THE DAY WE RECEIVE THEM

PRV 1A

70 10

6A 35A

I M-4

LM—4

• 0.03% Accuracy • 13 ranges:
4 vdc, 4 vac & 5 ohms • Automatic zeroing & polarity with
0.03% accuracy • Overload indication • Battery powered with
batteries & charger unit included
• Test leads included • 1.9"H x
2.7"W x 4.0"D \$227.00

LMM—3
The Volksmeter • 1% accuracy • 13 ranges: 4 vdc, 4 vac & 5 ohms.
• Automatic zeroing & polarity • Overload indication • Battery powered with batteries & charger unit included • Test leads included. • 1.9"H x 2.7"W x 4.0"D \$125.00

• Rugged, portable & battery powered with batteries & charger unit included • High sensitivity: 30 mV - 50 Hz to 30 MHz (100 mV - 10 Hz to 50 Hz & 30 MHz to 60 MHz) • Input overload protection • 1.9"H x 2.7"W x 4.0"D \$195.00

SAM'S BOOKS

LM-40
• 0.1% Accuracy • 13 ranges:
4 vdc, 4 vac & 5 ohms • Automatic zeroing and polarity with 0.1% accuracy • Overload indication • Battery powered with batteries & charger unit included
• Test leads included • 1.9"H x

NON-LINEAR SYSTEMS, INC.



IM-35

LM-3.5
The Volksmeter + 0.5% Accuracy
100% over-range • 19 ranges:
4 vdc, 4 vac, 5 ohms and, with the
3 current shunts which are
included, 3 dc amps and 3 ac amps Automatic zeroing and polarity with 0.5% accuracy - Overload indication - Battery powered with batteries & charger unit in-cluded - Test leads included - 1.9"H x 2.7"W x 4.0"O \$147.00

SC-5

**X 4.0"D | N × 4.0"D |

**Extends the range of the NLS |

**FM-7 Frequency Meter — and almost any 50 MHz frequency meter — to upper VHF and UHF |

**s • Auto-frequency bands • 30-mV sensimity with itvity • Accurate to 1 ppm sairty with batteries & charger included unit included - 1.9"H × 2.7"W × 1.9"H × 4.0"D • Interface cable & input \$190.00 |

**Section of the NLS |

**section of the

SAM'S BOOKS

TL Cookbook/No.21035/336 pgs \$8.95

IC OP-AMP Cookbook/20959/592 pgs \$12.95

Scenad Class Radiotelephone License Handbook, 5th Ed./21114/44 pgs. \$7.50

Scenad Class Radiotelephone License Handbook, 5th Ed./21111/448 pgs. \$7.50

Stand Class Radiotelephone License Handbook, 5th Ed./21111/448 pgs. \$3.95

Building & Installing Electronic Intrusion Alarms 70.92/2156 pg \$4.50

21031/3134 pgs. \$4.50

Understanding IC Operational Amplifiers 20959/136 pg \$3.95

Bail Electricity/Electronics Series, Vol. 1: Basic 21081/1460 pgs. \$4.50

Understanding IC Operational Amplifiers 20187/150 pgs \$5.50

Transistor Specifications Manual, 8th Ed. 21231/24 pgs \$6.95

TV Typswriter Cookbook/21313/256 pgs \$9.95

TV Typswriter Cookbook/21313/256 pgs \$9.95

SANKEN HYBRID

POWER AMPLIFIERS

AUDIO

FIRST

SGS-ATES - Audio Power Amplifier IC's

TBA800 5 watt TBA810S 7 watt TBA810AS 7 watt \$1.95 TBA820 2 watt
TBA830S 4.2 watt
TCA940 10 watt
TDA2002 8 watt
TDA2010 12W Hi-Fi 1.35 1.95 3.30 4.20 5.25 6.00 TDA2020 20W Hi-Fi Our Ancrona Information Book

101 contains 92 pgs of data & application notes on using SGS-ATES Audio Amps. Get your copy now. Only \$4.95

INTERSIL 8038 PRECISION WAVEFORM **GENERATOR & VCO**

\$3.90

P/N 8038CCPD

8080A/9080A 8-RIT MICROPROCESSOR COMPONENTS

C8080A	\$19.50
AM9080ADC	21.00
P8212	4.00
P8216	3.40
AM8224PC	5.90
P8226	3.50
AM8228PC	8.20
AM8238PC	8.20
C8251	14.30
COSEC	12 50

ACE 236



3,648 Solderless Plug-In Tie Points CAPACITY: Up to 36 14-Pin DIP's • 4 5-way binding posts • 10-1/4" x 9-1/4" • Fully assembled — 512 separate 5-tie point terminals 32 ver tical distribution buses (each with 5 connected 5-tie-point terminals) plus 4 horizontal buses (each with 18 con-nected 4-tie-point terminals). \$79.95

CLIPLITE 10 for \$1.50 New LED Mounting System



CLIPLITE mounts from the front of the Panel in a .250 hole on 3/8" centers. Panel thickness from 1/16" to 1/8".

CLIPLITE equalizes and increases the brightness of commonly used wide beam LEDS.

CLIPLITE is to be used with

CLIPLITE is to be used with .200" die, LEDS

Specify colors—red, green, ember, or yellow when ordering.

AUDIO POWER AMPLIFIERS 5.5 WATT AN315 Designed for mobile radios, tape players, etc. Easy to

use High Gain - 53 dB (Closed Circuit) \$3.90 ea

%W \$1.69 per 100 %W \$1.79 per 100								
10	100	1.0K	10K	100K	1.0M			
11	110	1.1K	11K	110K	1.1M			
.12	120	1,2K	12K	120K	1.2N			
13	130	1.3K	13K	130K	1.3M			
15	150	1.5K	15K	150K	1.5%			
16	160	1.6K	16K	160K	1.6M			
18	180	1.8K	18K	180K	1.8M			
20	200	2.0K	20K	200K	2.0M			
22	220	2.2K	22K	220K	2.2M			
24	240	2.4K	24K	240K	2.4M			
27	270	2.7K	27K	270K	2.7M			
30	300	3.0K	30K	300K	3.0M			
33	330	3.3K	33K	330K	3.3M			
36	360	3.6K	36K	360K	3.6M			
39	390	3.9K	39K	390K	3,9M			
43	430	4.3K	43K	430K	4.3M			

CARBON FILM RESISTORS (5%) Only in Multiples of 100 pcs per value (ohms)

00	1.0K	10K	100K	1.0M
10	1.1K	11K	110K	1.1M
20	1.2K	12K	120K	1.2M
30	1.3K	13K	130K	1.3M
50	1.5K	15K	150K	1.5M
60	1.6K	16K	160K	1.6M
0	1.8K	18K	180K	1.8M
00	2.0K	20K	200K	2.0M
0.5	2.2K	22K	220K	2.2M
10	2.4K	24K	240K	2.4M
70	2.7K	27K	270K	2.7M
00	3.0K	30K	300K	3.0M

430 470 510 560 620 680 750 820 4.3K 43K 430K 4.7K 47K 470K 5.1K 51K 510K 5.6K 56K 560K 6.2K 62K 620K 6.8K 68K 680K 7.5K 75K 750K 8.2K 82K 820K 9.1K 91K 910K 010

555C FROM FAIRCHILD MINI-DIPPKG 3 for \$1.00

MINI-DIP PKG 3 for child MN6040 C-MOS PLL — a single-chip phase-locked loop intended for use as a frequency synthesizer in C8 transceivers and other communications equipment. \$7.90

FLUKE MODEL 8030A DIGITAL MULTIMETER

3-1/2 digit, six-function multimeter. Measurement functions include ac volts (true rms), de volts, ac current (true rms), de current, resistance, and diode test. Each function, except the diode test, is supplemented by 5 selectable ranges for a total of 26 ranges (one range for diode test). \$250.00

FLUKE MODEL 80T-150C

Temperature Probe Converts a dc voltmeter into a thermometer with a range of -55°C to +150°C. .\$125.00

JAPANESE TRANSISTORS

	_		
2SC 1973	1.30	2SC828	.75
2SC 1974	3.00	2SC829	.75
2SC 1975	3.10	2SC1226A	1.25
2SC 2034	3.40	2SC1359	.90

AMD 2900 SERIES BIPOLAR MICROPROCESSOR **CIRCUITS**

1-9 10-up AM2901DC \$42.00 \$31.50 AM2902PC AM2905PC 10.10 8.10 AM2906PC 11.20 8 95 7.00 7.15 AM2907PC 8,95 AM2911PC 5.95 4.75 AM2913PC 4.10 AM2914DC AM2918PC 5.40 4.32 AM2919PC 4.50 3.81 AM29704PC AM29705PC 12.60 15.75 AM29720PC 5.00 4 20 AM29721PC AM29750DC 4.20 3.60 AM29751DC 4.50 3.60 6.80 6.80 7.65 5.50 5.50 AM29760DC AM29761DC AM29803DC 5.95 4.85 AM29811DC

MICROPROCESSOR KITS

	MICHOL HOCESSON KITS	
AMD		289.00
SIGNETICS	2650KT9000 - Microprocessor Kit	99.00
	F8 Microprocessor Kit	185.00
INTERSIL	IM6100 Microprocessor Tutorial System Includes following modules: 6950 Inter- cept Jr, 6951 Jr RAM, 6952 Jr Pro- grammable ROM-P/ROM & 6953 Jr Serial I/O	583.00
INTERSIL	6957 Audio Visuel Module for IM6100	125.00

PLESSEY

1" (26mm) GaAsP LED NUMERIC DISPLAY

(Common Anode) 1 Piece - \$4.90 3 Pieces - \$13.00 5 Pieces - \$19.00

PLESSEY SL1600 APPLICATIONS MANUAL Contains 114 pages circuit data system design and technical data for SL1600 Series Radio Com-munications Integrated Circuits. \$1,95

• • • •		٠	-	POLY	ESTEF	1 2	//		
				(CAPA	CITO	4 (F	M	INI E	XO
	MAT	2112	1	MF	V	5	MF	V	\$
				.001	1000	.14	.039	250	.15
	DIPE	PFD		.0012	1000	.14	.047	250	,15
-				.0015	1000	.14	.056	250	.15
1 /	ANTA	ALU	IN	.0018	1000	.14	.068	250	.15
CA	PAC	ITO	DC	.0022	1000	.14	.082	250	.17
CA	PAL	110	HO.	.0027	1000	.14	.1	100	.17
S	MF	V	\$.0033	1000	.14	.12	100	.18
.33	6.8	16	.40	.0039	630	.14	.15	100	.20
.33	6.8	35	.45	.0047	630	.14	.18	100	.21
.33	10.0	16	.42	.0056	630	.14	.22	100	.23
.33	10.0	25	.45	.0068	630	.14	.27	100	.26
.33	10.0	35	.90	.0082	630	.14	.33	100	.30
.33	15.0	20	.45	.01	630	.14	.39	100	.33
.33	15.0	35	1.32	.012	630	.14	.47	100	.36
.40	22.0	16	.45	.015	400	.15	.56	100	.44
.33	33.0	20	1.32	.018	400	.15	.68	100	.47
.40	47.0	20	1,53	.022	400	.15	.82	100	.54
.42	68.0	16	1.62	.027	400	.15	1.0	100	.60
45				.033	250	.15			

SI-1010G (10W output) . . . \$ 6.90 SI-1020G (20W output) . . . \$13.95 SI-1050G (50W output) . . . \$26.80 Data Sheet with Application Notes - \$0.50 NTINENTAL SPECIALTIES

39-439 Leather Case (used w/models LM-Series, FM-7, SC-5 S16.00

PROTO BOARDS & EXPERIMENTERS 1

Build & test circuits as fast as you think PB103 PB104 EX300 19.95 79.95 29.95 9.95 39.95 EX€00 10.95

PROTO BOARDS

With built-in regulated short-proof power supplied 5V, 1 amp regulated power supply 5V, 1 amp and ±15V, % amp regulated power supply

LOGIC MONITOR 1

Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs. Pocket size. \$74.95

LOGIC MONITOR 2

Displays static and dynami states of digital ICs such as C MOS, HTL, TTL, DTL & RTL Selectable threshold control

LOGIC PROBE LP-1

Compact, circuit-powered multifunction logic probe, Multi-family compatability, DTL/TTL/HTL/CMOS. Traces logic levels and pulses through digital circuitry. \$44.95

SOCKETS & BUS STRIPS

PROTO-CLIP

roand signal tracing, Bring ICA
Snap leads up from PC board
signal tracing, Bring ICA
Snap leads up from PC board
selects, shooting,
PC16 14-pin \$ 4.50
PC16 16-pin 4.75
2.50 PC14 24-pin 13.75
PC24 24-pin 13.75
PC3 40-pin 13.75
PC4 14-pin 3.75
PC4 14-pin 4.75
PC4 14-pin 13.75
PC4 14-Plug-in wire test modify or expand without patch cords or solder. Snap together to form breadboard needed Term'ls 118 20 94 16 70 12 36 24 16 Price \$12.50 2.50 10.00 PN/Description QT59S Socket QT59S Socket QT59B Bus QT47S Socket OT47B Bus QT35S Socket OT35B Bus QT18S Socket QT18S Socket OT8S Socket OT8S Socket

BREADBOARD JUMPER WIRE KIT Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0". Each wire is stripped and leads are bent 90° for easy insertion. Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box. BK-1 \$9.95

300 METALIZED CAPACITORS 18 DIFFERENT STD. VALUES \$26.00 RESISTOR KITS 5% CARBON FILM RESISTORS

MAY SPECIAL

AM1702A-6

ORIGINAL AMD

1.5 MSEC GUARANTEED 7 PIECE - \$ 5.90

8 PIECES - \$38.00



1/4 WATT KIT 42 Different Values (68 Ω to 4.7 M Ω) 20 Each Value 1/2 WATT KIT

PLESSEY SAMPLER

42 Different Values (68Ω to 4.7 MΩ) 20 Each Value

1/2W - \$25,90 PER KIT

COMPLETE WITH STORAGE BIN

CORDLESS HOBBY-WRAP TOOL-BW-630

Weighs ONLY 11 Ounces

Wraps 30 AWG Wire onto Standard DIP Sockets (0.025 Inch Complete with built-in bit and sleeve

\$34.95 (betteries not included)

WIRE-WRAP KIT - WK-2-W

Roll of 50 ft. White 30 AWG Wire

50 pcs, each 1", 2", 3" & 4" lengths — pre-stripped white wire

\$11.95

WRAP . STRIP . UNWRAP - \$5.95

WIRE WRAP WIRE - 30 AWG 25 ft. min. \$1.25 50 ft. \$1.95 100 ft \$2.95 1000 ft \$15.00 SPECIFY COLOR: White, Yellow, Red, Green Blue or Black

1-24 25-49 50 UP .16 .19 .21 .28 .34 .36 .37 .44 .59 .14 .17 .19 .26 .32 .34 .35 .42 .57 .20 .27 .33 .35 .36 .43 .58

Battery Operated (Size C)

WRAP . STRIP . UNWRAP

Tool for 30 AWG Wire

WIRE WRAP TOOL WSU-30

DIP SOCKETS LOW PROFILE, SOLDER,

STANDARO, SOLDER,

.23 .25 .27 .32 .65 .45 .90 1.26 1.45

40 Pin 1.59 1.46 1.30 STANDARD SOLOER, GOLO 8 Pin 30 27 .24 14 Pin 35 .32 .29 16 Pin .38 .35 .32 .32 18 Pin .52 .47 .43 .22 Pin .70 .63 .57 28 Pin 1.10 1.00 .90 38 Pin 1.75 1.40 1.63 .36 Pin 1.75 1.40 1.65 .40 Pin 1.75 1.59 1.45 WISEWARD COLO WINEWARD COLO 8 .30 .30 Pin 1.75 1.40 1.45 .40 Pin 1.75 1.59 1.45

WIREWRAP GOLD
WIREWRAP GOLD
(Level No. 3)
10 Pin .45 .41 .41
14 Pin .39 .38 .41
16 Pin .43 .68
18 Pin .43 .68
18 Pin 1.05 .95
20 Pin 1.40 1.25 1.36 Pin 1.59 1.55 1. .37 .37 .41 .62 .85 1.10 1.30

FAIRCHILD TECHNOLOGY KITS Complete Specifications on Back of Each Kit DIGITS

FTK0001 0.5" High Common Cathode Digit FTK0002 0.5" High Common Anade Digit FTK0003 0.5" High Common Cathode Digit FTK0004 0.8" High Common Cathode Digit FTK0005 0.8" High Common Anade Digit 2.00 0.8" HIGH DISPLAY ARRAYS FTK0010 12 Hour, 3% Digit Clock Display 8.00 FTK0021 10 Red LED Lamps
FTK0021 10 Red LED Lamps
FTK0021 5 Mixed Colored LED Lamps
FTK0022 10 LED Mounting Clips
FTK0023 5 Three Piece LED Mounting Adapters 1.00 PHOTO TRANSISTORS FTK0030 5 Flat Lens Photo Transistors
FTK0031 5 Round Lens Photo Transistors
FTK0032 3 Flat Lens Photo Darlingtons
FTK0033 3 Round Lens Photo Darlingtons 1.00 1.00 1.00 PHOTOARRAYS
FTK0040 9-Element Tape Reader Array
FTK0041 12-Elament Card REadar Array
FTK0042 Reflective Opto Coupler 24.00 4.00 COUPLERS FTK0050 3 General Purpose Opto Couplers FTK0051 Darlington Opto Coupler MOS CLOCK CIRCUITS FTK0400 Digital Clock/Calendar Circuit (FCM7001) 7.00 (FCM7001)
FTK0401 Digital Clock/Calendar with BCD
Outputs (FCM7002) 7.00 Outputs (FCM7002)
FTK0402 Direct Drive Digital Clock Circuit
with AC Output (FCM3817A)
FTK0403 Direct Drive Digital Clock Circuit
with DC Output (FCM3817D)
FTK0405 Direct Drive Digital Clock/Calend 5.00

FTK0J06 Automobile Clock Kit FTK0101 6-Digit Wall Clock/Calendar MAIL ORDER ADDRESS - P.O. Box 2208P, Culver City, CA 90230. Send check or money order, COD, Master Charge and BankAmericard welcomed. Minimum Order: **CRONA** \$10.00. Add \$1.00 to cover postage and handling. California residents add 6% sales tax. TELEPHONE ORDERS: Call (213) 641-4064.

ANCRONA STORES DO NOT ACCEPT MAIL OR TELEPHONE ORDERS

CALIFORNIA o. 101 INFORMATION

CALIFORNIA

ARIZONA ANCRONA 4518 E. Broadway (602) 881-2348

OREGON ANCRONA 1125 N.E. 82nd Ave Portland, OR 97220 (503) 254-5541

GEORGIA ANCRONA 3330 Piedmont Rd., NE Atlanta, GA 30305 (404) 261-7100

TEXAS **ANCRONA** 2649 Richmond Houston, TX 77098 (713) 529-3489

Direct Drive Digital Clo Circuit (FCM7015) KITS

CANADA R.C. ANCRONA Vancouver

ANCRONA 11080 Jefferson Blvd. Culver City, CA 90230 (213) 390-3595

ANCRONA 1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 547-8424

CIRCLE NO. 8 ON FREE INFORMATION CARE

MAY 1977

6.00

6.00

BOOKS AND MAGAZINES

FREE book prophet Elijah coming before Christ. Wonderful bible evidence. Megiddo Mission, Dept. 64, 481 Thurston Rd., Rochester, N.Y. 14619.

BACK ISSUE MAGAZINES. 1890 to 1976. Free list. Send stamped envelope to Everybody's Bookshelf, Dept. PE, 317 West 6th, Los Angeles, CA 90014.

BUSINESS OPPORTUNITIES

I MADE \$40,000.00 Year by Mailorder! Helped others make money! Free Proof. Torrey, Box 318-NN, Ypsilanti, Michigan 48197.

FREE CATALOGS. Repair air conditioning, refrigeration. Tools, supplies, full instructions. Doolin, 2016 Canton, Dallas, Texas 75201.

MAILORDER MILLIONAIRE helps beginners make \$500 weekly. Free report reveals secret plan! Executive (1K5). 333 North Michigan, Chicago 60601.

GET RICH with Secret Law that smashes debts and brings you \$500 to \$5 Million cash. Free report! Credit 4K5, 333 North Michigan, Chicago 60601.

HIGHLY PROFITABLE ONE-MAN **ELECTRONIC FACTORY**

Investment unnecessary, knowledge not required, seles handled by professionals. Postcard brings facts about this unusual opportunity. Write today! Barta-DR, Box 248, Walnut Creek, CA 94597.

FREE SECRET BOOK "2042 UNIQUE, Proven Enterprises" Fabulous "Little Knowns". Work home! Haylings-B, Carlsbad. Calif. 92008.

HOW TO MAKE \$2,000 WEEKLY at home using other people's money. Guaranteed. Free Details. Richlieu. Box 25357, Dept. F5, Houston 77005.

MAKE BIG MONEY in spare time selling: Tubes, Antennas, Speakers, Test Epuipment, Lite Bulbs, Hi-Fi, etc. No investment. Free information: Allied Sales, Pimento. IN 47866. (812) 495-6555.

LIFETIME OPPORTUNITY for mechanically/electronically inclined individuals. Operate Successful Manufacturing Business. Mark, 92-K Brighton 11th, Brooklyn, New York 11235.

NEW LUXURY Car Without Cost. Free Details! Codex-ZZ, Box 6073, Toledo, Ohio 43614.

STUFF ENVELOPES \$250 + /Thousand, supplies. Enclose stamped, addressed envelope. Enterprises, Route One, Box 263-E5, Pauls Valley, OK 73075.

MISCELLANEOUS

WINEMAKERS: Free illustrated catalog yeasts, equipment. Semplex, Box 12276P, Minneapolis, Minn. 55412.

POPULAR ELECTRONICS INDEXES For 1976 now available. Prepared in cooperation with the Editors of "P/E," this index contains hundreds of references to product tests, construction projects, circuit tips and theory and is an essential companion to your magazine collection. 1976 Edition, \$1.50 per copy. All editions from 1972 onward still available at the same price. Add \$.25 per order for postage and handling, \$.50 per copy, foreign orders. INDEX, Sox 2228, Falls Church, Va. 22042.

Price 8.95 5.95 49.00 14.95 2.50 4.50 4.50 4.50 10.00

> 6.95 6.95 6.95

14 95 11.00 11.00 31.50 3.18 8.10

7.00 7.15

4.32

3.00 2.50 2.95 1.75 1.00

1.50

185.00

TTL 7400N SN7400N .13 SN74125N SN7401N .14 SN74126N SN7402N .14 SN74128N		POWER SCHOTTKY				CI	MOS	
		LOMEN SCHOLLKI				U	れいろ	
SN7403N .14 SN74132N SN7403N .17 SN74132N SN7405N .17 SN74131N SN7405N .17 SN74131N SN7405N .25 SN74142N SN7407N .25 SN74143N SN7407N .25 SN74143N SN7413N .17 SN74143N SN7409N .17 SN74143N SN74143N SN7411N .20 SN74143N SN7411N .20 SN74143N SN7412N .21 SN7415N SN7415N .29 SN7415N .39 SN7415N .39 SN7415N .39 SN7415N .24 SN7415N .24 SN7415N .25 SN7415N .25 SN7415N .25 SN7415N .25 SN7416N .25 SN7421N .20 SN7415SN .25 SN7416N .25 SN7421N .20 SN7415SN .25 SN7416N .25 SN7423N .25 SN7416N .25 SN7423N .25 SN7416N .25 SN7416N .28 SN7428N .22 SN7416N .28 SN7428N .28 SN7416N .28 SN7428N .28 SN7416N .28 SN7428N .28 SN7416N .28 SN7416N .28 SN7428N .28 SN7416N .28 SN7416N .28 SN7428N .28 SN7416N .28 SN7416N .28 SN7428N .29 SN7416N .28 SN7416N .28 SN7428N .21 SN7416N .28 SN7417N .29 SN7418N	2.75 SN74LS47N 1. 1.69 SN74LS48N 1. 1.69 SN74LS48N 1. 2.4 SN74LS51N 9.4 SN74LS51N 1.77 SN74LS53N 1.76 SN74LS53N 1.77 SN74LS63N 1.79 SN74LS74N 1.49 SN74LS74N 1.49 SN74LS76N 1.74 SN74LS76N 1.74 SN74LS76N 1.75 SN74LS98N 1.75 SN74LS98N 1.74 SN74LS98N 1.75 SN74LS90N 1.04 SN74LS91N 1.04 SN74LS13N 1.05 SN74LS112N 1.70 SN74LS112N 1.71 SN74LS12N 1.72 SN74LS12N 1.73 SN74LS12N 1.74 SN74LS12N 1.75 SN74LS13N	233 SN74LS138N 233 SN74LS139N 233 SN74LS151N 238 SN74LS151N 238 SN74LS155N 238 SN74LS155N 23 SN74LS156N 23 SN74LS156N 23 SN74LS158N 23 SN74LS16N 25 SN74LS16N 25 SN74LS16N 25 SN74LS16N 26 SN74LS16N 27 SN74LS16N 28 SN74LS16N 29 SN74LS16N 20 SN74LS16N 20 SN74LS16N 20 SN74LS16N 21 SN74LS16N 22 SN74LS16N 23 SN74LS16N 23 SN74LS16N 23 SN74LS16N 24 SN74LS175N 25 SN74LS19N 27 SN74LS19N 27 SN74LS19N 28 SN74LS19N 29 SN74LS194N 20 SN74LS194N 20 SN74LS194N 21 SN74LS194N 22 SN74LS194N 23 SN74LS194N 24 SN74LS22N 25 SN74LS22N 26 SN74LS22N 27 SN74LS196N 28 SN74LS22N 29 SN74LS22N 20 SN74LS23N 20 SN74LS22N 20 SN74LS22N 20 SN74LS22N 20 SN74LS22N 20 SN74LS22N 20 SN74LS23N 20 SN74L	1.25 1.35 1.199 1.45 1.90 1.45 1.50 1.50 1.50 1.50 1.50 1.50 1.50 1.5	AM2918PC AM2918PC F8 Kit Power Data Bi-Potar Mer	(1 Micros (1.5 Micros (1.5 Micros (1.5 Micros (1.5 Micros (1.5 Micros) 6 Micros) 6 Micros (1.5 Micros) 6 Micros) 6 Micros (1.5 Micros) 6 Micros) 6 Micros	JOS AND BI-P second) 256 x osecond) 256 x osecond) 256 PROM (450 NI S CPU (2 mic Ram 1024 x Bit Static Shi OS FIFO 1 Mit Arithmetic Pricessor Learni FO mic RAM Plas BIT IC RAM 1024 40 NS Open (40 NS Open (40 NS Tri-Sta Polar Microprok Ahead Cirinput Bus Transceive scadable Micrograte State (150 New Microprok Carlotte) (150 New Microp	99 .99 .99 .99 .99 .99 .99 .99 .99 .99	on MM ds) S) er er er Register ule IS (18 Pin) IS (22 Pin) INS) single 5V supply slice ri-State Receiver and m Sequencer and Tri-State Outputs on Kil with Software
SN7495AN .67 SN742/8N SN7495AN .65 SN7428AN SN7496N .65 SN7428AN SN7410AN .42 SN7428SN SN7410AN .42 SN74296N SN74107N .28 SN74296N SN74107N .28 SN74296N SN74110N .52 SN74355N SN74110N .52 SN74356N SN74111AN .69 SN74356N SN7411AN .40 SN7436N SN7411AN .40 SN7436N SN7412N .40 SN74396N SN7412N .40 SN74396N SN7412N .40 SN74399N SN7412N .48 SN74399N SN7412N .48 SN74399N	1.64 LCC4151 Linear and I	ook	12.95 3.95 4.95 4.95 3.95 2.95 2.95 2.95	Linear Integ Low Power S Interface Da Raytheon Linea	rated Circ Schottky a ta Book Integrated ntific CMOS	uit Data Book nd Macrologie Circuit Data Book 'B' Series Data B	C TTL	

We offer the largest variety of current production Texas Instruments and Fairchild Semiconductor only 74LS devices from stock. Even though the competition for current production major manufactured 74LS devices is limited, we are dedicated to provide the best prices possible. As our costs decrease, we pass the savings on to you, our customer.

an unbeatable combination. Get the most value for your Dollar Electronic provides the three essentials in Semiconductor

3. PRICE

We now offer the lowest mix pricing for major manufacturers devices only, with the largest variety of devices available from stock, from one We offer Rolls Royce quality at Volkswagen pricing.

P.O. BOX 1035

FRAMINGHAM, MASSACHUSETTS 01701 Telephone Orders & Enquiries (617) 879-0077 New Catalogue available on request NOW IN CANADA 5647 Ferrier st. 44 Feaken Dr-Unit 25 MINIMUM ORDER \$10.00 * ADD \$1.00 TO COVER POSTAGE & HANDLING * Canadian customers add 30% for duty and handling. All federal and provincial taxes extra.

CIRCLE NO. 3 ON FREE INFORMATION CARD

Popular Electronics

MAY 1977 ADVERTISERS INDEX

REA	DER VICE	NO.	ADVERTISER	PAGE NO.
1 2 3 6 7 8	ACO Acti Adv Allis And	R Electron ustic Fib ive Electron anced M son Autor crona Cor	s, Inc nics rer Sound Systems, Ir ronic Sales Corp icrocomputer Produc motive Company p cts, Inc	
10 11 12	Bull	et Electr	t of Dynascan ronics tions	118
15	In Clev El	stitute eland In ectronic	Radio Engineering stitute of s, Inc	28, 29, 30, 31
13 14 16	Cro	tinental wn	Specialties Corporation	on 89
17 18 67	Digi Digi Digi Digi	-Key Cor tal Conce tal Group tal Group	porationepts	
19 20 21 22 64 23 24 25	Edii Edm Elec Elec Eltre Emp	e Electronund Scietronic Betronics I	onics entific Co ook Club Unlimited ntific SCREEN Projection S	112 105, 124 7 99 120
26 27	Grai	ntham Co	cs., Bill ollege of Engineering	103
28 5	Hea	th Comp	A. Incany	80, 81, 82, 83
30 31 32	Illine Inte	ois Audio rnational	facturing Corporation I Electronics Unlimite	
33 34			ronics ument Corp	
35 36 37 38	McI Mali Mid Mot	ntosh La lory & Co land Inte orola	boratory Inc b., Inc., P.R.	63 5 5 23 27
39 40	Nati	ional Car /-Tone El	nera ectronics	102
41 42 43 44	OK Olso Opto	Machine on Electro oelectror	& Tool Corporation & Tool Corporation onics	
45 46 47 48 49 69	Pea Pers Pick	e CB rce-Simp sonal Cor cering &	onicsoson, Incoson, Magazine	.FOURTH COVER 2 95THIRD COVER
50			onics	
51 52	Rad	lio Shack	,	37
53 54 55 56 57 58 59 60 61	S A S.D Sch Scie Sen Sha Soli Sou Spe Sup	E Sales Coober Orgentific Recore kespeared State State Sthwest The State	conjugate Corp. The conjugate Company	93 113 104 59 86 35 120 rporation 15 104 116, 17
29			ments Incorporated.	
65 4	U.S	. Pionee	r Electronics o Products, Inc	52, 53
66 68	Wah	l Clippe	Corporation	99
		IED ADV	ERTISING 05, 106, 112, 114, 1	

PLANNING TO Let us know 8 weeks in advance so that you

von't miss a single issue of POPULAR ELECTRONICS

Attach old label where indicated and print new address in space provided. Also include your mailing label whenever you write concerning your subscription. It helps us serve you promptly.

Write to: P.O. Box 2772, Boulder, CO 80323, giving the following information:

☐ Change address only ☐ Extend my subscription

ENTER NEW SUBSCRIPTION

- ☐ 1 year \$9.98 Allow 30-60 days for delivery.
- □ Payment enclosed (1 extra BONUS issue) ☐ Bill me later

Name	please print
Address	
City	
State	Zip
ame	
ddress	please print
ty	

P.O. Box 4430C Santa Clara, CA 95054

ELECTRONICS

(408) 988-1640

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

						MESSEA	1 00	CD4027	.55			
7400TTL		74L800 TTL		LM309K	.95	MESSSA	1 00	CD4028	1.50			
7400N	.17	74LS00N	28	LM311H	.90	NESSOV	1 85 1.25	CD4029	1.70			
7402N	17	74LS02N 74LS04N 74LS05N	.28	LM311N	.90	NES87V	1.25	CD4030 CD4035	.42			
7403N	.17	74L504N	34	LM317T	2.95	78L05	.90	CD4035	2.00			
7404H	.19	74LSUSN	34 .34 .28 .28	LM318	1.35	78L08	1.00	CD4040	1.35			
7405N	.22	74LS08N	-50	LM320K-5 LM323K-5	6.95	79L05	1.00	CD4042	1.50	8098	.75	
7407N	.42	74LS10N	-20	LM302K-12	1.70	75107	26	CD4043	2.00	8097	.75	16
7409N	.17	74LS13N	.87	LM320K-15	1.35	75108	1.75	CD4044	2 00	8098	.75	Soldst
74109	.17	74LS14N	1.30	LM3207-5	1.60	75451CH	.39	C04048	2.90	ATO9	1.25	PIN 1
7415N 7413N	.28 .78	74LS20N 74LS22N	.34	LM3201-8	1,60	75452CR 75453CH	.39	CD4049	62 55	5710	4.50	8 .
	.78	74LS22N	41	LM320T-12	1.95	75453CH	.37	CD4050	.53	8T20	5.50	14
74148	.63	74L530N	.28	LM320T-15	1.50	75454CN 75491EN	.37	CD4051 CD4060	2.10	8T23	3.10	16
7420M 7422N	1.39	74L\$33N	20	LM324N	1.45	75491EH	.30	CD4066	2.10	BT24	3.50	81
7430H	.20	74LS38N	39	LM339N	1,55	75492CN	.37 .50 .55	CD4068	.85 25	8125	3.20	22
7433N	39	74LS74N	.46	LM340K-5	1 50	75484CN	.89	CD4069	.40	8T26	2.75	MON
7438%	25	74LS75M	.65	LM340K-8	1.60	DISCRETER		CD4070	40	8T28	2 75	1702A
74400	17	74LS90N	1.10	LM340K-12	1,60	IN4001	.08	CD4071	40	8T97	2.45	N8252 N8251
7442N	78	74LS93N	1,10	LM340K-15	1.60	1164002	.08	CD4072	40	8198	2.45	MB2512
7445N	.85	74LS95N	1.89	LM340K-24	1.60	1944003	.08	CD4073	40	MOS/MEMORY P		N82512 N82512
7446N	1.04	74L5107H	52	LM3407-5	1 50	194004	.08	CD4075	40	2101-1	4.50	R62314
7447N	.50	74L5112N	52	LM340T-8	1.70	RH005	80.	CD4076	1 75	2102-1	1.80	2708 DM857
744830	.50	74LS113N	52	LM340T-12	1.70	114005		CD4078	.40	21078	8.00	SPECIA
7450N 7473N	17	741 S132N	1.15	LM340T-15	1 70	IN4733A	.23	CD4081	40	2111-1	7.00	LM181
7473N	36	74LS136N	.59	LM340T-18	1 50	IN4733A IN4734A IN4736A	25 25 25 25 25 25 25 25 25 25 25 25 25 2	CD4082	.45	2112-2	7.90	LIMIGIA
7474N	.12	74LS151N	1.60	LM340T-24	1.70	IN4738A	20	CD4116	1.30	2513B 21L02-1	8 75	LM390
7475N		74LS155N	1.50	LM343H	4.25	1N4739A	28	CD4490	5.50	MM5058	2.20	Oscil
7482N	1.75	74LS157H	1.40	LM348	2.40	3M4742A	25	CD4508	4.25	MM5080	3.20	Bwitch
7483N	.70	74LS162N 74LS163N	2.05	LM350	1.00	IN4744A	25	CD4510	2.00	MM5262	.90	Mom.
7485N	.99	74LS163N	2.05	LM351	2.40	LN4746A	95	CD4511	2 20	MM5120	5.95	On off
74896	2.00	74LS174N	1.85	LM358N	1.15	IN4749A	25	CD4516	4.00	MMESSO	9.75	On non
7490N 7492N	.45	74LS190N 74LS221N	2,60	LM370 LM377	4 50	1064752A	.26	CO4516	2 00	PD4110-3	7.00	Encode
7493H	.45		1.95	LM379	4 50 5.00	IN4751A IN4752A	.26	CD4518	2.45	PD411D-4	8.00	HD0 3 Digit
7495N	.49	74LS258N	4.20	LM380N	1.00	IN4784A	.25	CD4520 CD4527	2.90 4.75	C) OCKR	0100	3 Eligit
74100N	.75 .90 39 .85	74L00		LM381	1 60	29/3904	.25 .25	CD4528	4.73	MM5309	3.90	Counts
74107M	10	74L00	.30	LM382	1 60	2N3906	.25	CD4556	1.50 5.75	MM5311	3.60	to 5 Mi
74109N	85	74L02	30	LM385	1 75	A to D CONVE	MIEM	CD4553 CD4566	2.25	MM5312	4.80	10 5 MI
741210	.39	741.74	.60	LM703H	40	8700CJ 8701CN	13.95	CD4583	4.50	MM5313	3.60	display
7412384	67	74L65	1.60	LM709H	28	B701CH	22.00	CD4585	2.10	MM5314	3.93	MART/I
741250	45	74L89	3 13	LM723H	50	LD138	13.75	CD40192	3 00	MM5315	4.00	AY5-10
74132N	1.25	74800 TTL		LM723N	44	CHOS		74030	26	MM5316	5.00	3341
74145N	AD.	74\$00 74\$02	29	LM733N	1 00	CD34001 Fair.	.50	74004	33	MM5318	8.95	REBUSA
74150N	.95	74502	29	LM741GH	35	CD4001	25	74C10	.28	MM5388	2 10	Va watt
74151N	1.10	74504	30 90	LM741W	25 82	CD4002	.25	74C14	2 10	MM5371N MM5841	5.50	10 b
74154N	1.10	74510	90 68	LM747H LM747N	62	CD4008	1 35	74C20 74C30	28	C17001	10.80	25 p
74155N	.85	74574	06	LM747N	62 35 82	CD4007	.25	74C30	28	MM5375AA/N	3.90	10 p 25 p 100 p
74157N	.95	LINEAR		LM1303H	82	CD4008	1 50	74C48	2.95	MM537SAB/N	4,90	1000 p
74181N	.95	CA3026	1.00	LM1304	1 10	CD4009 CD4010	.00	74074	75	7205	16.50	MISCE
74162N	1.35	CA3045	1.00	LM1305	1 27	CD4010 CD4011	22	74C78 74C90	1.40	DS0029CN	3.75	12 Vot
74163N	1.35	CA3045	90 95	LM1307	2 00	CD4012	23	74093	1 15	DS0056CN	3.75	trens
74174N	1 19	CA3049	85	LM1310	2.75	CD4013	53 25 25 40	74C106	2.10	MM53104	3.75	
74175H	2.40	CAROLA	1 00	LM1458	59	CD4014	1.25	740100		MICADPROCESS		LEDS
74181N	1 15	CA3054 CA3081	1 89	LM1800	75	CD4015	1.25	740154	3.00	8080 with data	19.00	Red 10
74190N 74192N	1.25	CA3062	1.90	LM1812	7 50	CD4016	.50	740160	1 44	8080A with date		Graen 1
741934	85	CA3086	1.40	LM1869	3.00	CD4017	1.00	74C192	2,40	8212	4 50	Orange Yellow
74221N	1.55	CA3089	1 40 2.95 4.75	LM2111	1 75	CD4018	2.75	74C221	2.75	6224	8.50	Jumpo
74285N	6.00	CA3090A0	4.75	1 M 2902	1 50	CD4019	2.00	74C905	3.00	6228	8 50	Jumbo
74298N	1.65	LM301AN	.35	LM3900N	.55	CD4020	1.35	740906	1.50	CDP1802CD	29.50	Jumbo
74365N	1.65	LM301AH	.35	LM3905	1 75	C04021	1.20	74C925	10.50	CDP1802D	35.00	Jumbo
74388N	2.90	LM305H	.87	LM3909N	.69	CD4022	1.40	74C926	10.50	KEYBGARDS		Cilailte
74357N	2.00	LM307N	35	MC1458V	.59	CD4023	.25	740927	10.50	53 Key Keyboard	818 RS	Clipilta
74368N	2.00	LM308N	.89	NE54DL	3.90	CD4024	.88	INTERFACE		with HD0185	4.0.00	(spe
		LM309H	1.15	NESSON	.85	CD4025	-25	5095	.78	encoder add	6.95	gree

6.20

12 50 149 95

Not a Cheap Clock Kit \$17.45 Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Same clock kit with .80"

Digital Temperature Meter Kit

Indoor and outdoor. Automatically switches back and forth. Beautiful. 50° LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure -100° to +200°F, air or liquid. Very accurate. Complete instructions.

8080A Microcomputer Kit

8080A CPU, Crystal Clock, I/O Buffers, RAM and PROM. D/A—A/D converter. PROM Programmer. Memory expandable. Complete documentation incl. assembly instruct., programming etc. \$195.00

1977 IC Update Master

Manual Brand new. Complete integrated circuit data selector from all manufacturers. 1264 page master ref. guide to the latest IC's including microprocessors and consumer circuits. 17,000 cross references for easier sourcing of hard to get parts. \$30.00 with free update service thru 1977. Domestic postage add \$2.00. Foreign \$6.00.

Frequency Counter Kit
Covers audio, ultrasonic and low amateur
band 10 Hz to 2.5 MHz typ. Dual channel
high sensitivity = 25 millivolts. Crystal
controlled clock. Can be prescaled for
higher frequency. 6-.50° digits. Full instructions. Less power supply. \$40.00

Stopwatch Kit \$26.95

Full six digit battery operated. 2-5 volts. 3.2768 MHz crystal accuracy. Times to 59 minutes, 59 seconds, 99 1/100 hrs. Times standard, split and taylor. 7205 chip all components minus case. Full instruct.

COSMAC 'ELF'

COSMINC LET.

RCA CMOS Microcomputer

CDP1802 CD \$29.50 Users Manual \$7.50

Complete kit of parts to build the "ELF"

including CDP1802 and users manual as

listed in August '76 Pop. Elect. minus

power supply and board. \$92.00

VOLUME SPECIALS

		1	10
MM5262	ZK RAM	90	.5
MM5369	Divider	2 10	1.4
2102-1	500 NS 1K RAM	1 80	1.3
FND503	50" Display	1 00	8
18MHz	Crystal	3 90	2.5
PD411-3	150 NS 4K RAM	8 00	57
MA1002E	5" Alarm Clock Mod	8 95	7 8
MA1013E	7" Alarm Clock Mod	10 95	8.9
MM5309	Clock	3.90	27
MM5314	Clock	3 90	27
Momentary Pr	ushbutton Switch	50	2
	Other parts also availa	ble	

60 Hz Crystal Time Base

Kit \$4.75 Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

SCMP Keyboard Kil \$95.00 SCPMP Kit \$99.00

Clock Modules

Cromplete alarm clocks ready to hook up with transformer and switches. Very compact with .50" and .84" digits.

MA 1002A, C or E .50" \$ 8.95
102P3 Transformer \$ 2.25
MA 1010A, C or E .84" \$11.95 \$11.95 \$ 2.25 102P2 Transformer Special transformer and six switches when purchased with module \$ 2.95

Stopwatch/Timer Kit \$55.00

4 Digit, 7 function programmable stop-watch/timer. Two PC boards, components and case. Crystal controlled, this kit is excellent for rally and events as well as navigational, photography and for appliance control

Auto Clock Kit \$15.95 DC clock with 4-.50" displays. Uses National MA1012 module with alarm option.
Crystal time base PC boards and full instructions. Add \$3.95 for a beautiful dark gray case ready to install. This is the best value available anywhere!

TERMS: \$5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted.

FREE: Send for your copy of our 1977 QUEST CATALOG. Include 13¢ stamp.

AMAZING & HARD-TO-FIND SCIENCE BUYS ALTERNATE ENERGY SPACE AGE · HOBBIES

3000 MI. POWER FOR AM RADIOS



Remarkably clearer reception of ball games far off, your old hometown, up to 3000 mi. away "subject to local cond." deluxe Ultrasensitive indoor directional AM Antenna for hi-fi, tuner inputs

No. 72,263AV ...(31/15x91/16x11")......\$117.50 Ppd.

SAVE 50%! 8 x 20 MONOCULAR



Top quality Spy Scope, a \$30 value, now \$14.95! Special purchase saves you 50% 100% coated optics: 393 ft. field of view. Only 2 oz.—stores in pocket, purse, glove box. No.1568AV .. \$14.95 Ppd.

SAVE 50%-DELUXE AM/FM WALL RADIO



Surplus Philco-Ford radio chassis (141/4x13 13/16x31/2") mounts sis (14/4x13 - 9/16x3/2) mounts anywhere. 11 transist., AM/FM hi-sens. tuner, AFC, 2¾" dia. speaker. Orig. cost \$30 ea. in 3,000 quant. Retail over \$40.

72,275AV (NEW! READY TO PLAY!) \$19.95 Ppd. SAVE \$6 MORE! BUY 3 OR MORE @ \$47.95 Ppd

NASA-CHOSEN FOR APOLLO/SOYUZ



The Astronauts used this super 20X60 binocular (modified) to view Earth! Big 60 mm objective lenses; 173-ft. field of view at 1000 yds. Relative brightness, 9.0. Fully coated optics, more!

No. 1556AV(91/4x81/2"; 47.5 oz) \$99.95 Ppd.

SOLAR ENERGY CUBE



Demonstration of sunlight converting to kinetic energy! Clear plastic cube in sun with its 3 silicon solar cells powers motor to whirl the propeller. Actually produces 1.5v DC, 825 ma.

.....\$23.95 Ppd. No. 42,287AV (4x4x4") ..

LOW COST PORT, INFRA-RED EYE



Self-cont. scope (90'nite vision) has 6032 IR converter tube, f/3.5 telephoto lens, adjust. triplet eyepiece. 1.6X Not avail. to Cal. res. except spec. au-

(6,12v DC) . No. 1683AV .\$299.95 Ppd. No. 1685AV (SUPER 2.5X BINOC.)\$329.95 Ppd.

PRO ELECTRONIC SOUND CATCHER



Parabolic mike w/ 1834" trans-parent reflecting shield & 2 I.C.'s in amplifier magnifies signals 100X over omni-direction mikes. Catch sounds never bef. heard; highest signal to noise ratio poss. 5½ lb.

No. 1649AV (REQ. 29V BATT.).....\$299.00 Ppd.

15% EFFICIENT SOLAR CELL!



Largest, most powerful ever for terrestrial use, to build solar panels where max. power per unit area is req. Output up to 12w per sq. ft. Produces .8A @ .45 v; .38w output. 2" x 2" sq. 2 OZ.

No. 42,514AV.\$39.95 Ppd.

MEASURE WIND SPEED ANYWHERE



Hold handy (16 oz.!) low cost Anemometer into the wind, quickly read wind speed on its big dial—from 5 to 70mph. Acc. ±3% of full scale (2.1 mph) no batts., adjustments, recali bration req.!(71/2" HIGH) No. 42,428 AV..\$19.95 Ppd

QUALITY DETECTOR UNDER \$40



Our fully transistorized BFO unit can locate a quarter at 18".
Powerful 6 trans.-oscillatoramplifier circuit. Comp. to others priced 50% more! Aluminum, just 2 lb No. 80,222 AV \$39.95 Ppd

EDMUND SCIENTIFIC CO

300 Edscorp Bldg., Barrington, N.J. 08007 • (609) 547-3488 America's Greatest Science . Optics . Hobby Center



SUPER POWER FOR **ANY AM RADIO**

New Antenna Assist Turns A Tiny Transistor Into A Tiger!

This amazing antenna assist has pulled in stations up to 1000 miles away! Just set it beside your radio (no wires, clips, grounding) and fine-tune Select-A-Tenna's dial to the same frequency— gangbusters ! Terrific for sportsmen, vacationers, shut-ins, radio & electronics buffs, Service men & women—anyone who wants to "get" home to a favorite station. Great for clearing weak signals in radio depressed areas, off-coast islands, stations in crowded frequencies, hard-to-tune stations way up on the dial. Solid state-no tubes to replace. Uses no electricity or batteries-works almost forever! Tough, break-resistant plastic case Se \$1995 STOCK NO. 72,095 N blends with any decor.

ULTRA SELECT-A-TENNA (TUNES OVER 1000 MILES AWAY)

Currently in use on Alaska's north slope where radio reception is very difficult. Has jack input & jack to which you attach 50 ft. of antenna wire (not included)

STOCK NO. 72,147 AV ONLY

The Edmund BIOSONE II

turns brainwaves into an audible or visual signal, \$149.95

KNOW YOUR ALPHA FROM YOUR THETA!

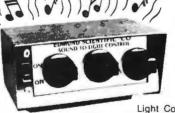
For greater relaxation, concentration . . monitor your alpha/theta brainwaves.

Features Normally Found Only In Units Selling For More Than \$200.00-And 3 Feedback Modes.

More Inan \$200.00—And 3 Feedback Modes. The portable, professional quality Edmund Biosone II boasts 3 feedback modes—LED FM tone, threshold tone; a test mode to check overall system of operation. Easy to use, this beautiful 4-pound, simulated walnut unit (9½ x 5¾ x 4½") can be operated at home, in office or clinic, it gives you outputs to allow further monitoring of logic signal, raw EEG, filter output, meter, and FM. Total brainwave monitoring capability, incl. (5-100 microvolts). Completely safe, the Edmund Biosone II is similar to an electroencephalograph (EEG), enabling you to identify the electrohemical activity that exists at all times in the human brain. In addition to letting you know when you're most relaxed. Biosone II is a great conversation piece. Included at its low price are a set of electrodes, an earphone jack for private use. Uses latest advances in linear circuitry. earphone jack for private use. Uses latest advances in linear circuitry, runs on two 9v transistor batteries (not included).

STOCK NO. 1668AVJust \$149.95 ppd. LOW COST STARTERS' UNIT, No. 71,809AV

C IN PULSATING CO



ASSEMBLED \$ 1850 Ppd. NO. 42,309AV

UNASSEMBLED, IN KIT FORM

The Edmund 3-Channel Color Organ

COMPLETELY ASSEMBLED! LESS THAN HALF THE PRICE OF OTHER MODELS!

Create your own audio "light show", add a new dimension to your music listening pleasure with the bargain-priced Edmund 3-Channel Sound To

Light Control. Lets you modulate 3 independent strings of colored lamps with the intensity of your music. They flash and vary in brightness related to the music's rhythm, pitch and volume-a pulsating light performance to music! You get volume and frequency sensitivity to a peak rating of 300 watts per channel. Just plug in your favorite colored flood or spotlight, and turn on! Great price, too. This high quality, fully No. 42,336AV ONLY 15 Ppd. assembled unit in metal housing, with 3 individually controlled circuits, is priced at less than half that of others. Complete instructions are included with this terrific value.

GIANT FREE 164 PG. CATALOG

4000 UNUSUAL BARGAINS FOR HOBBYISTS. SCHOOLS, INDUSTRY

COMPLETE AND MAIL COUPON NOW

DMUND	SCIENTIFIC	CO.	300 Edscorp	Bldg.,	Barrington,	N.	J.	08007
			Send me t					

AMERICAN ECRESS	BANKAMERICARO Autor (a	haster charge		
SEND FRE	E CATALOG "	۸۷″		

Charge my American Exp BankAmericard Master Cho.

Interbank No. Card No.

Expiration Date 30-DAY MONEY-BACK GUAR-ANTEE. You must be satisfied or return any purchase in 30 days for full refund.

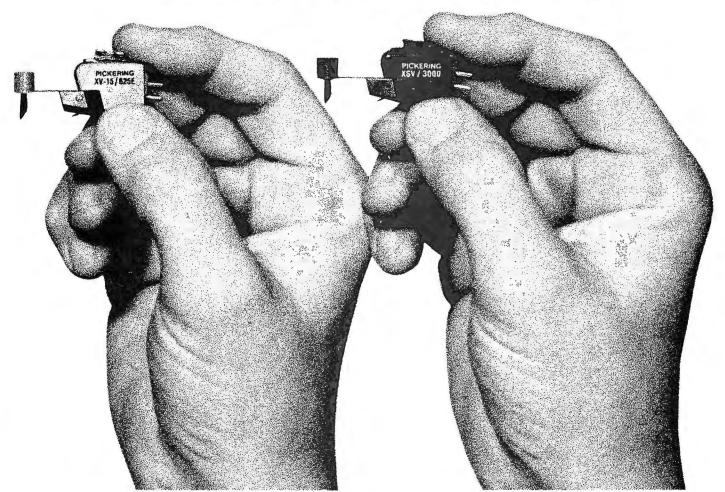
Send me the s Stock No.	Quantity	Price Ea.
Enclosed is	andling charge check, amount of	\$1.00 \$
Signature		

Address

City, State, Zip.

CIRCLE NO. 21 ON FREE INFORMATION CARD

Two sources of perfection in stereo sound.



Match one to your equipment

"The right Pickering Cartridge for your equipment is the best Cartridge money can buy.'

We've been saying that for years; and tens of thousands of consumers have profited by applying this principle in assembling their playback systems.

If you have a fine manual turntable, the XSV/3000 is a perfect choice.

If you have a high quality automatic turntable, then installing an XV-15/625E in its tone arm is a perfect choice.

The summary advice of Stereo's Lab Test, in an unusual dual product review, we think brilliantly states our position: "The XV-15/625E offers performance per dollar; the XSV/3000, the higher absolute performance level." That makes both of these cartridges best buys!



Pickering's new XSV/3000 is a remarkable development. It possesses our trademarked Stereohedron Stylus Tip, designed to assure the least record wear and the longest stylus life achievable in these times with a stereo cartridge. Its frequency response is extraordinarily smooth and flat; its channel separation is exceptional; its transient response affords superb definition. It represents a whole new concept of excellence in stereo cartridges.

Read the whole evaluation report. Send for your tree copy of the Stereo "Lab Test" reprint; write to

Pickering & Co., Inc., 101 Sunnyside Blvd., Plainview, N.Y. 11803.

Department PE 5 PICKERING & CO., INC., COPYRIGHT 1977



That bad language on your CB may not be bad language.

It may be bad CB.

Every CBer knows who the enemy is.

Static.

And while nobody yet has come up with a way to kill it, Pace has hurt it. A lot.

Because every Pace CB has a minimum of six noise suppressors built into it. Some as many as nine!

So, while there's still no such thing as noise-free CB, a Pace comes as close to it as you're going to get.

Pace. We're very bluenosed about bad language. So we're doing everything we can to clean up the CB airwayes.



When you've got a Pace 40-channel CB, you've got the world by the ears.

PACE 40 CHANNEL MODEL #8015

For your convenience there are seven Pace regional warranty centers, plus more than 300 independent Pace service repair centers around the nation,